SIEMENS

SITRANS F

Flowmeters

FUS060 transmitter with PROFIBUS PA

Operating Instructions

Edition 05/2014

Answers for industry.

SIEMENS

SITRANS F

Ultrasonic Flowmeters FUS060 transmitter with PROFIBUS PA

Operating Instructions

Ultrasonic flow transmitter type FUS060 with PROFIBUS PA for use with sensor types SONO 3100, SONO 3300 and SONOKIT.

05/2014

A5E02225054-002

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Introduction 1

These instructions contain all the information you need for using the device.

The instructions are aimed at persons mechanically installing the device, connecting it electrically, configuring the parameters and commissioning it, as well as service and maintenance engineers.

Note

It is the responsibility of the customer that the instructions and directions provided in the operating instructions are read, understood, and followed by the relevant personnel before installing the device.

The contents of this manual shall not become part of or modify any prior or existing agreement, commitment or legal relationship. The sales contract contains all obligations on the part of Siemens as well as the complete and solely applicable warranty conditions. Any statements regarding device versions described in the manual do not create new warranties or modify the existing warranty.

The content reflects the technical status at the time of publishing. Siemens reserves the right to make technical changes in the course of further development.

1.1 How to read the Operating Instructions

The Operating Instructions only describe the transmitter part of the flowmeter system, consisting of a sensor type SONO 3100, SONO 3300 or SONOKIT 1-path or 2-path and a transmitter type FUS060.

The sensors have separate Operating Instructions.

1.2 Precision measuring system

The ultrasonic flowmeter is a precision measuring system that is “user friendly”, but must be installed in accordance with the instructions given in these operating instructions.

1.3 Literature overview

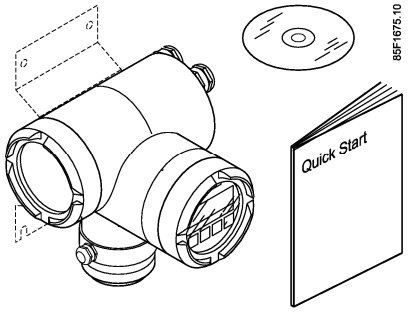
For flowmeters based on the FUS060 transmitter various technical literature such as operating instructions and quick start guides are available on the CD-ROM shipped with the device, or it can be found on the Internet at www.siemens.com/flowdocumentation (www.siemens.com/flowdocumentation), where further information on the SITRANS F flowmeter range is also available.

SITRANS F US sensor and transmitter versions have separate operating instructions.

These Operating Instructions concern only the FUS060 HART transmitter part of the flowmeter system. The FUS060 PROFIBUS PA transmitter version and SONO 3100, SONO 3300 or SONOKIT sensors have separate operating instructions.

1.4 Items supplied

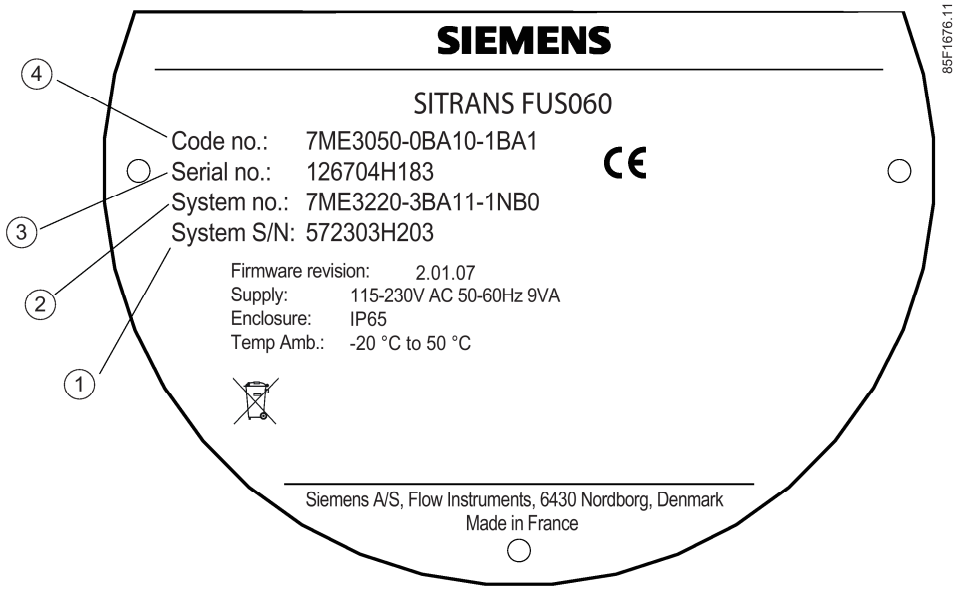
- SITRANS FUS060
- Wall mounting bracket (standard only)
- SITRANS F documentation disk
- Quick Start guide



Inspection

1. Check for mechanical damage due to possible improper handling during shipment. All claims for damage are to be made promptly to the shipper.
2. Make sure the scope of delivery, and the information on the type plate corresponds to the ordering information

1.5 Device identification



① System S/N System serial number
② System no. System order number
③ Serial no. Transmitter serial number
④ Code no. Transmitter order number

Figure 1-1 FUS060 identification nameplate example

1.6 History

The contents of these instructions are regularly reviewed and corrections are included in subsequent editions. We welcome all suggestions for improvement.

The following table shows the most important changes in the documentation compared to each previous edition.

Edition	Remarks	FW versions	EDD version
04/2009	First edition	2.01.0	1.00.01
05/2014	• Diagnostics section improved • Specific PROFIBUS description added • Description of new functions added • General update according to FW update	3.00.00	2.00.00

1.7 Further Information

Product information on the Internet

The Operating Instructions are available on the CD-ROM shipped with the device, and on the Internet on the Siemens homepage, where further information on the range of SITRANS F flowmeters may also be found:

Product information on the internet (http://www.siemens.com/flowdocumentation)

Worldwide contact person

If you need more information or have particular problems not covered sufficiently by these Operating Instructions, get in touch with your contact person. You can find contact information for your local contact person on the Internet:

Local contact person (http://www.automation.siemens.com/partner)

Safety notes

2

2.1 General safety instructions

⚠ CAUTION

Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Only qualified personnel should install or operate this instrument.

Note

Alterations to the product, including opening or improper modifications of the product are not permitted.

If this requirement is not observed, the CE mark and the manufacturer's warranty will expire.

2.2 Laws and directives

General requirements

Installation of the equipment must comply with national regulations. For example EN 60079-14 for the European Community.

Instrument safety standards

The device has been tested at the factory, based on the safety requirements. In order to maintain this condition over the expected life of the device the requirements described in these Operating Instructions must be observed.

NOTICE

Material compatibility

Siemens Flow Instruments can provide assistance with the selection of wetted sensor parts. However, the full responsibility for the selection rests with the customer and Siemens Flow Instruments can take no responsibility for any failure due to material incompatibility.

Conformity with European directives

The CE marking on the device symbolizes the conformity with the following European directives:

Electromagnetic compatibility EMC 2004/108/EC	Directive of the European Parliament and of the Council on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.
Low voltage directive LVD 2006/95/EC	Directive of the European Parliament and of the Council on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.
Atmosphère explosible ATEX 94/9/EC	Directive of the European Parliament and the Council on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres.
Pressure equipment directive PED 97/23/EC	Directive of the European Parliament and of the Council on the approximation of the laws of the Member States concerning pressure equipment.

The applicable directives can be found in the EC conformity declaration of the specific device. Further country or region-specific code conformity information is available on request.

2.3 Installation in hazardous area

⚠ WARNING

NOT allowed for use in hazardous areas!

Equipment used in hazardous areas must be Ex-approved and marked accordingly!

This device is NOT approved for use in hazardous areas!

Description

3

3.1 Overview

The SITRANS F US ultrasonic flowmeter systems consist of a sensor and a transmitter. This system consists of sensor type SONO 3100, SONO 3300 or SONOKIT and the transmitter type FUS060. The following table shows the ultrasonic flowmeter systems with the transmitter type FUS060:

Sensor type	Transmitter	Outputs	Measurement
SONO 3100 DN 100 – DN 1200 SONO 3300 DN 50 – DN 300 SONOKIT DN 100 – DN 4000	FUS060	• PROFIBUS PA • 1 frequency/pulse	• Volume flow rate • Total volume • Mass flow rate • Total mass • Sound velocity • Error indication • Limit monitoring • Ultrasonic amplitude

These Operating Instructions is only for the transmitter part of the flowmeter system. The SONO 3100, SONO 3300 or SONOKIT sensors have separate operating instructions.

The FUS060 is configured in a combination of hardware (HW) and firmware (FW). For communication via SIMATIC PDM firmware-specific device descriptions are needed. The various relations are listed below:

Device		Device description	
HW	FW	1.00.01	2.00.00
02.00	2.01.04	X	
02.00	2.01.07	X	
02.00	3.00.00		X

3.2 Design

SITRANS FUS060 is an ultrasonic flow transmitter engineered for high performance and suitable for use with 1-path, 2-path, and 4-path flow sensors.

The complete flowmeter consists of an ultrasonic flow sensor of the types SONO 3100, SONO 3300 or SONOKIT and the associated SITRANS FUS060 transmitter.

The ultrasonic flow sensors are available with diameters up to DN 4000.

Figure 3-1 FUS060

3.3 Measuring principle

Physical principle

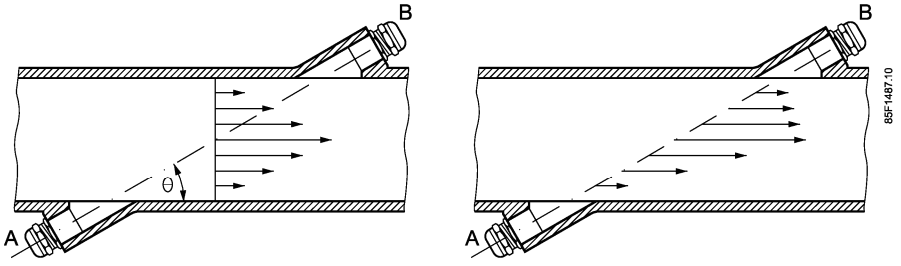


Figure 3-2 Velocity distribution along sound path

A sound wave travelling in the same direction as the liquid flow arrives at point B from point A in a shorter time than the sound wave travelling against the direction of flow (from point B to A).

The difference in sound transit time indicates the flow velocity in the pipe.

Since delay time is measured at short intervals both in and against flow direction, temperature has no influence on measurement accuracy.

SITRANS F US flowmeters

In SITRANS F US flowmeters the ultrasonic transducers are placed at an angle θ in relation to the pipe axis. The transducers function as transmitters and receivers of the ultrasonic signals. Measurement is performed by determining the time the ultrasonic signal takes to travel with and against the flow. The principle can be expressed as follows:

$v = K \times (t_{B,A} - t_{A,B}) / (t_{A,B} \times t_{B,A}) = K \times \Delta t/t^2$
where
v = Average flow velocity
t = Transit time
K = Proportional flow factor

This measuring principle offers the advantage that it is independent of variations in the actual sound velocity of the liquid, that is independent of the temperature.

The proportional flow factor K is determined by wet calibration or calculated by "AUTO" in case of manual programming of mechanical/geometrical pipe data (SONOKIT only). The

transducer angle (θ), distance between sensors (L) and pipe dimension (D_i and D_u) are shown in the figure below.

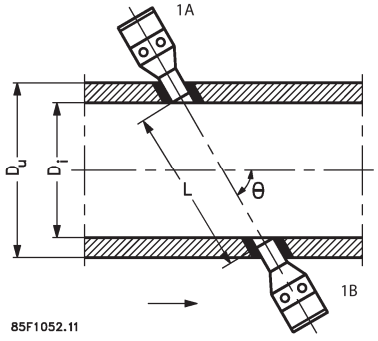


Figure 3-3 Measuring principle

The ultrasonic signal is sent directly between the transducers. The advantage gained sending signals from point to point is an extremely good signal strength.

3.4 PROFIBUS communication

PROFIBUS (Process Field Bus) is an open communication system for automation engineering which is being used in its thousands all over the world and which is specified in the European standard EN 50170.

PROFIBUS PA

PROFIBUS PA (PA = Process Automation) is a variant of PROFIBUS DP which is used widely in production engineering. It has special a transmission technique and therefore satisfies the requirements of process automation/materials processing. This transmission technique is defined in the international standard IEC 61158-2. The low transmission speed reduces the power loss and therefore enables an intrinsically safe technology for use in areas where there is a high explosion risk. Line, star and tree structures are possible as well as combinations of these. All kinds of field devices such as transducers, actuators, analyzers, etc. can be connected to the PROFIBUS PA. The essential advantage in addition to the saving of installation costs is the possibility of a more detailed diagnosis with an increase in the availability of the plant components. Furthermore, the automatic updating of plant documentation and plant optimization during ongoing operation is supported.

Use in the automation system

Several PROFIBUS PA lines are linked to the fast PROFIBUS DP in an automatic system. The process control system is also linked to this. Both bus systems use a uniform protocol layer. Thus the PROFIBUS PA is a communication-compatible extension of the PROFIBUS DP into the field.

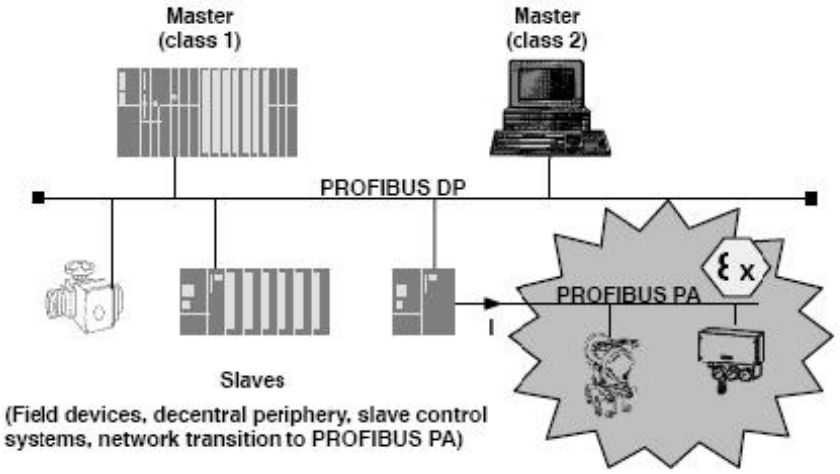


Figure 3-4 Section of typical PROFIBUS automation system

Masters

The control system consists of two masters with shared tasks:

- Master class 1 takes care of the control and regulating tasks
  Measuring and actuating data are exchanged cyclically between Master class 1 and the field devices. The status information signals of the field devices are transmitted parallel to these data and evaluated in the class 1 master. No field device parameters are set or other device information read during cyclic operation. The information necessary for establishing communication is available to the control system from the stored, device-specific device data base files GSD.
- Master class 2 allows operating and monitoring functions.
  One or more class 2 masters can access the field devices acyclically in addition to the cyclic mode. With this communication type further information can be fetched from the devices or settings made in the devices.

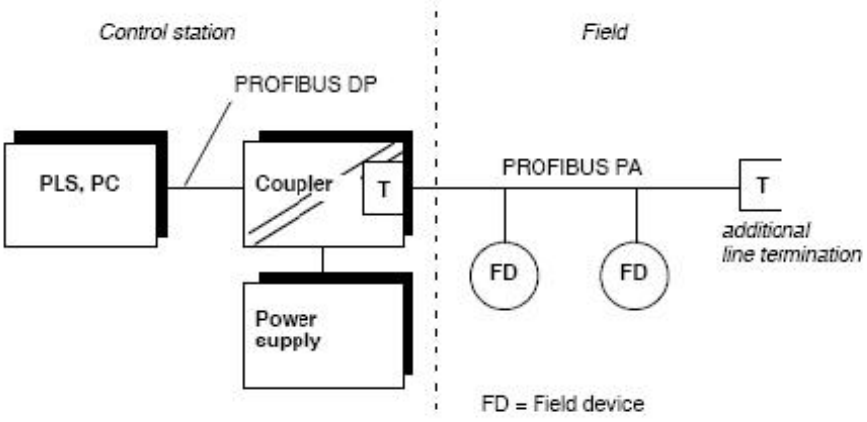
PROFIBUS PA Architecture

PROFIBUS PA enables bi-directional communication between a bus master and the field devices over a two-wire cable. At the same time the power is supplied to the two-wire field devices through the same cables.

Supplementary to the EN standard 50170, the PNO (PROFIBUS user organization (http://www.profibus.com/)) has defined the scope of functions of the individual field device types in a so-called profile description. These profiles define the minimum functional requirements and optional extensions. A device-internal "Device Management" supplies all necessary basic information for finding the profile parameters to the control system

configuration tools. In this way a parameterizing tool can operate all devices which conform to profile no matter what their type and manufacturer.

The system must be implemented with one or more PROFIBUS PA lines depending on the automation job and thus the number of field devices. A PROFIBUS PA line consists of the components illustrated below.



PLS / PC	Responsible for the control
DP/PA coupler / DP/PA link	Signal conversion DP-PA, bus feeding and bus termination are unified in the "coupler" device.
T	Terminating resistor. Must be fitted at the far end of the bus for transmission-technical reasons
Power supply	Power supply unit with safety extra-low voltage (SELV). The power supply must have adequate reserves for bridging brief power failures.
FD	Field Device. The individual field devices can be connected almost anywhere in the bus system

Figure 3-5 PROFIBUS PA architecture

Line length and maximum number of devices

The central process control system PLS or, in the case of low requirements, a PC, is responsible for the control. As a rule the functions signal conversion DP-PA, bus feeding and bus termination are unified in the "coupler" device. A DP/PA coupler or, in the case of higher requirements, a more powerful DP/PA link is used depending on the number of PROFIBUS PA field devices to be operated in the automation system. An additional terminating resistor must be fitted at the far end of the bus for transmission-technical reasons. The theoretically possible line length (total of all line sections) is a maximum 1900 m when using the recommended bus cable. However, the current requirements of the individual users and voltage drop at the cable must be taken into account in the planning. The individual field devices FD can be connected almost anywhere in the bus system.

See the "PNO Guide PROFIBUS PA (http://intranet.siemens.no/docs/ind/Anl_losn/Aut_pls/Tekn_beskr/Profibuss/syspa_e.pdf)" for further information.

The DP/PA coupler or DP/PA Link is supplied by a power supply unit with safety extra-low voltage (SELV). This power supply must have adequate reserves for bridging brief power failures.

The maximum number of devices that can be connected to a bus line depends on their current consumption and the respective application conditions. When operating in an area where there is no risk of explosion, the couplers/links can feed up to 400 mA into the bus.

⚠ WARNING

Use in hazardous areas

When operating in explosion risk areas, the intrinsic safety is only guaranteed when the maximum power fed into the bus does not exceed certain voltage and current values.

These are normally:

- Current IS < 128 mA
- Voltage U0 <15 V

⚠ WARNING

Intrinsically safety

Only certified supply units (DP/PA couplers or DP/PA links) may be used to feed the intrinsically safe PROFIBUS. See the EC Type Examination Certificate for requirements.

The number of devices which can be connected to a bus line is given by the total of maximum current consumptions of the connected devices (>= 10 mA per device is the standard).

A current reserve should be planned for safety, otherwise there is a risk that a defective device overloads the bus with its increased current consumption and the power supply and communication with all unaffected users could collapse. The power reserve quantity depends on the current increase in the event of an error specified by the manufacturer.

Note

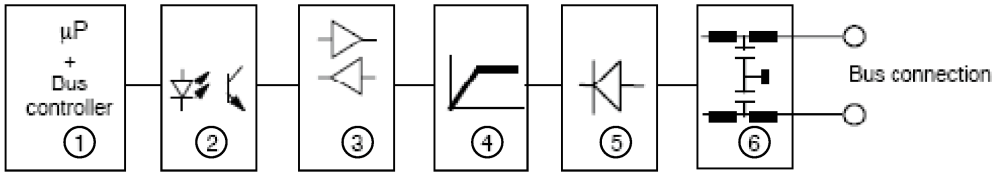
The electronic current limiter installed additionally in the device ensures that the current does not increase by more than 5 mA even when a device is defective.

Note

Every device has its own address to distinguish between the connected process devices. The address setting is described in the Commissioning (Page 33).

PROFIBUS PA interface

The PROFIBUS PA variant of the SITRANS FUS060 differs from the 4 to 20 mA / HART version in the bus interface and the omission of the digital output 2. This means that the basic functions of the device including the operation and display remain basically the same. Function blocks 1 to 6 take care of the interface tasks to the bus.



① The microprocessor interprets the bus command, initiates device-internal actions and provides measured values, status and device data on the bus.

② The device internal electronics are isolated from PROFIBUS PA by the potential isolator.

③ The bus interface contains the transmit and receive circuits for the bus system.

④ The electronic current limiter ensures that no illegally high current flows in the event of an error. This avoids bus overloading and ensures that data communication with the other unaffected users is maintained.

⑤ The reverse polarity protection enables the bus cables to be connected at any terminals and makes installation errors almost impossible.

⑥ An EMC filter prevents malfunctions in the case of electromagnetic interference.

Figure 3-6 Block diagram of the bus link

Scope of function

SITRANS FUS060 with PROFIBUS PA provides the following measured values and values derived from measured values using PROFIBUS and local display.

- Flow (volume or mass flow)
- Sound velocity
- Ultrasonic amplitude
- Quantity (volume or mass) net, forward and reverse

An upper and lower limit can be specified for all measured values. An appropriate message is indicated in the measured value status when a limit value is reached. Diagnostic messages are also indicated in the event of malfunction or special states.

The device has a wide range of setting facilities, for example, measuring range scaling, definition of the flow direction, residual flow suppression, attenuation of measured values etc. The settings are made on the PROFIBUS or using the local keyboard with menu guidance.

The quantity values (volume and mass) are derived from the flow value by accumulation (volume or mass forward from all positive flow values, volume or mass reverse from all negative flow values, and volume or mass net from all flow values with the correct sign) and also have setting facilities for the limit values but no scaling.

The flow values can also be issued as a frequency or pulse sequence at "digital output 1".

Status information on quality and compliance with limit values is provided with the measured values. Further diagnosis data can be called up if there are device errors.

The following functions are implemented in addition to the standard device according to the PROFIBUS device profile:

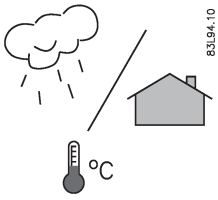
- User-specific scaling of all measured variables in the form of a linear representation between any range of the measured variable ("measuring scale") and the actual output variable ("output scale").
- A measuring range does not need to be set, the valid measuring range is only limited by the respective sensor limits (see chapter below).
- Upper and lower warning limit for each measured variable to supplement the existing alarm limits.
- Upper and lower warning and alarm limits for each totalizer, with selectable hysteresis for the net totalizer.

The following functions on the standard device with 20 mA / HART interface are not available on the PROFIBUS version as they can generally be replaced indirectly by the PROFIBUS functions.

- Analog output (4 to 20 mA)
- HART communication
- Digital output 2 (relay output)

Installing/Mounting

4



SITRANS F flowmeters with minimum IP65/NEMA 4X enclosure rating are suitable for indoor and outdoor installations.

- Make sure that pressure and temperature specifications indicated on the device nameplate / label will not be exceeded.

Note

Installation in hazardous location

his device is **NOT** approved for use in hazardous areas.

In the following it is described how to install the transmitter and how to turn the local display in order to optimize the viewing angle.

Note

Before starting the installation of the device please read the "PNO Guide PROFIBUS PA" for further information. This guide must be followed when installing it.

4.1 Transmitter installation

Standard mounting plate

1. Fit the mounting plate on the transmitter using the mounting material provided.
2. Mount transmitter with mounting plate on the wall.

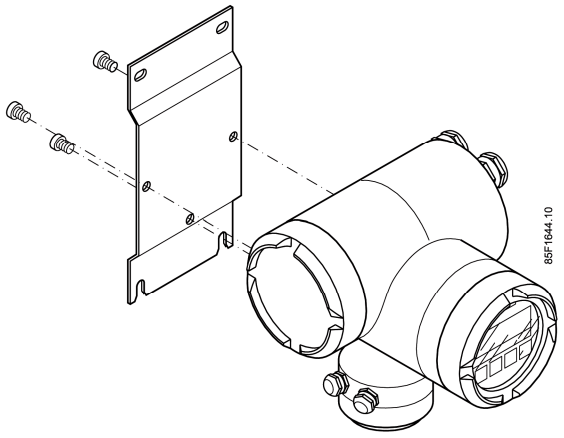


Figure 4-1 Standard mounting plate

Note

The standard mounting plate is only suitable for wall mounting.

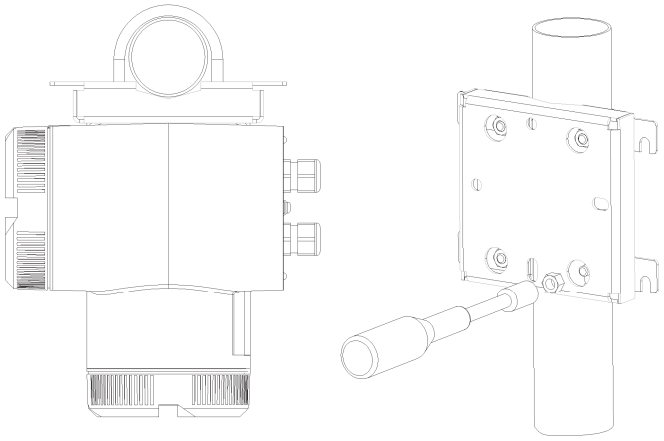
Optional pipe or wall mounting assembly bracket

Note

The assembly bracket is not part of the standard delivery and must be ordered separately.

Pipe mounting

1. Mount the assembly bracket on the pipe using the fastening brackets
2. Fasten the transmitter with the two screws provided.



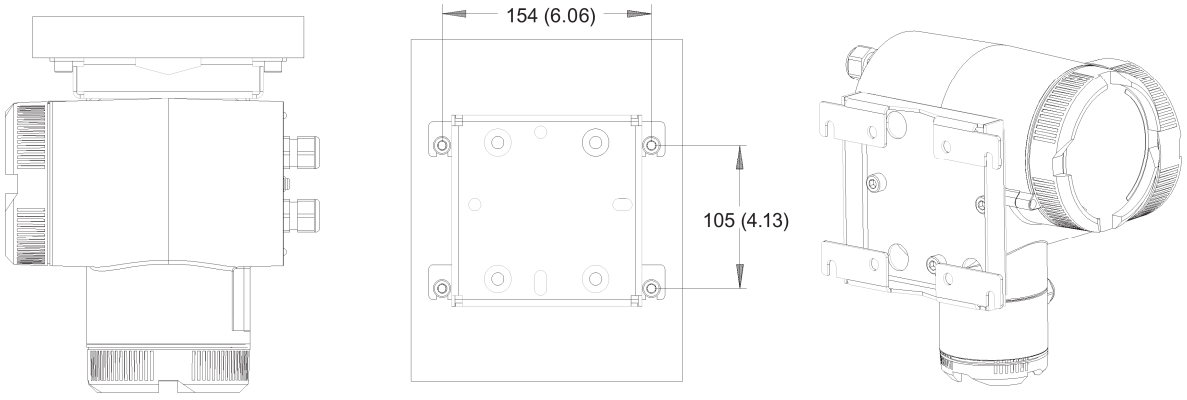
Pipe mounting with assembly bracket

Wall mounting

1. Fasten the assembly bracket to the back of the transmitter
2. Fasten the transmitter and assembly bracket to the wall

Note

The fastening brackets and nuts are not needed for wall mounting.

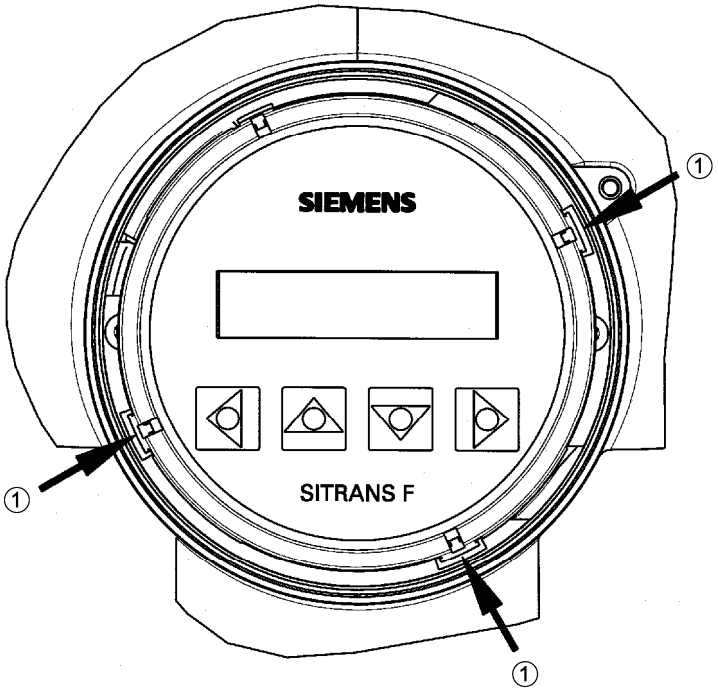


Wall mounting with assembly bracket. Dimensions in mm (inch).

4.1.1 Turning the local display

The local display can be turned in 90° steps to enable better reading in case of vertical installation or overhead assembly.

1. Switch off the power supply.
2. Release the catch on the lid of the electronics compartment with a 3 mm Allen key.
3. Unscrew the cover.
4. Carefully release the fastening hooks of the local display using a screwdriver or similar tool
5. Pull out the unit, turn it to the desired position and push it back in.
6. Screw the lid back on and mount the lid catch.



① Fastening hooks

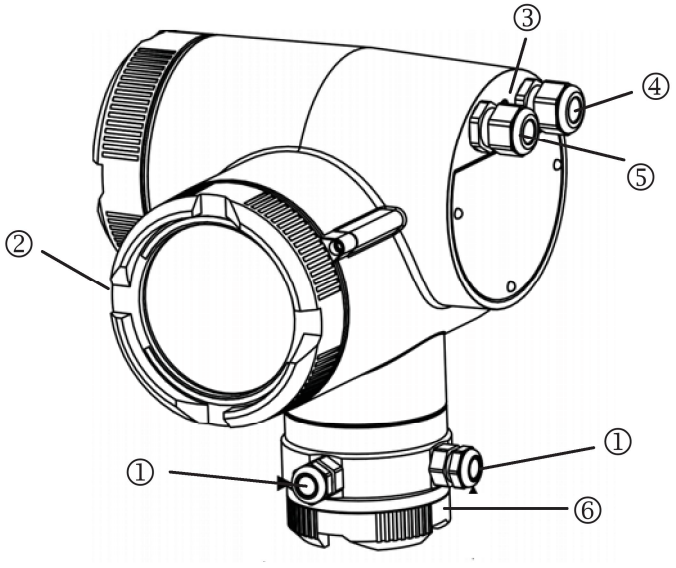
Figure 4-2 Unlocking the fastening hooks on the local display

Connecting

5

This chapter describes how to wire up the device in two steps:

- Step 1: Wiring the transducer cables (Page 27)
- Step 2: Wiring output and power supply (Page 29).
- Step 3: Wiring PROFIBUS PA (Page 31)



① Transducer cable entry (4 entries)
② Terminal box lid for power supply and signal cables
③ Potential equalization (PE connector)
④ Output cable entry
⑤ Power supply entry
⑥ Terminal box lid for transducer / sensor cables

Figure 5-1 Overview electrical connections

Note

The connection of the transducers on the sensors type SONO 3100 and SONOKIT (both with SONO 3200 transducers) or in the terminal housing of sensor type SONO 3300 is described in the separate sensor operating instructions.

Safety measurements

⚠ WARNING

Qualified personnel

Only qualified personnel may carry out work on the electrical connections.

⚠ WARNING

Use in hazardous locations

Special requirements apply to the location and interconnection of sensor and transmitter.
See Installation in hazardous area (Page 12)

⚠ WARNING

Danger of electric shock!

Never install the device with the mains voltage switched on!

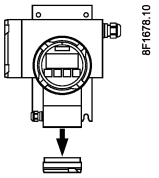
The version for power supply 19 to 30 VDC may only be connected to SELV or PELV circuits.

Cable specifications

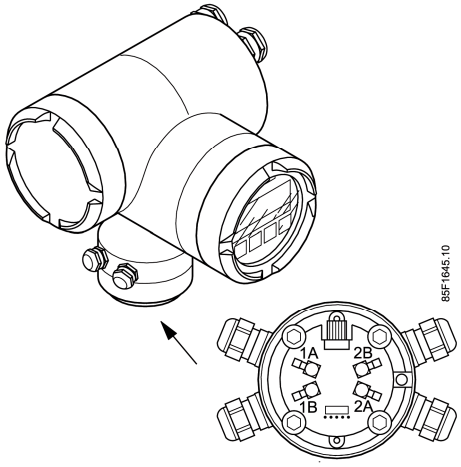
- Use cables with a cross section of at least 1.5 mm2 and double or reinforced insulation for the power supply.
- Lay heat-resistant cables if high temperatures can occur on the housing, eg due to conduction of heat by the sensor/metering tube. Lay the cables so that they do not come into contact with the hot sensor/metering tube.
- Lay signal cables separately from cables with voltages > 60 V.
- Use cables with twisted wire pairs.
- Earth transmitter housing.
- Cables used for connection must have diameters fitting the glands.
- Use shielded cables for the outputs
- Compare data on rating plate with local power supply.

5.1 Wiring the transducer cables

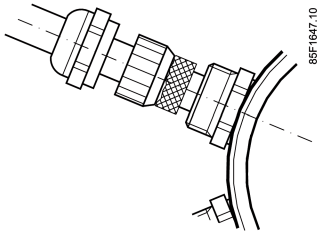
1. Unscrew the bottom lid from the terminal box.



2. Connect the cables to the transducers according to type of system (1-path or 2-path, see below).



3. Carefully press the cables into the cable glands until the "snap" function fixes the cable inside the connection module. Make sure the cables are mounted correctly by smoothly pulling the cable.



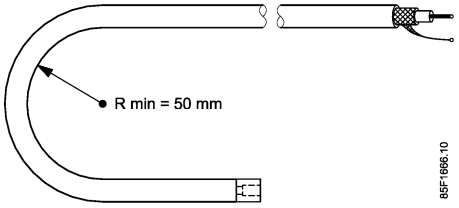
4. If necessary, the transducer cables can be shortened at the respective transducer / sensor end (the high temperature versions).
Make sure the cables are equal in length in order to avoid signal delays in the signal processing.

Note

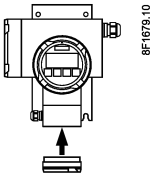
The SITRANS F US sensor is shipped with 2 or 4 transducer cables of fixed lengths of 3, 15, 30, 60, 90 or 120 m (9.84, 49.21, 98.43, 196.85, 295.28, or 393.70 ft).

Note

The allowed minimum transducer cable bending radius is 50 mm.

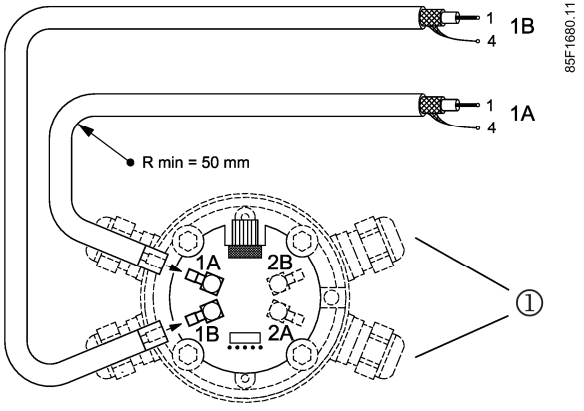


5. Tighten the cable glands on the threaded bush until the cable is sealed tightly (IP65).
6. Screw the lid back on.



7. After the installation, check and, if necessary, correct the cable length setting of the transmitter (see menu 7).

Wiring 1-path systems



① For 1-path sensors exchange the two unused cable glands with the blind plugs.

Figure 5-2 Wiring transducer cables, 1-path system.

Wiring 2-path systems

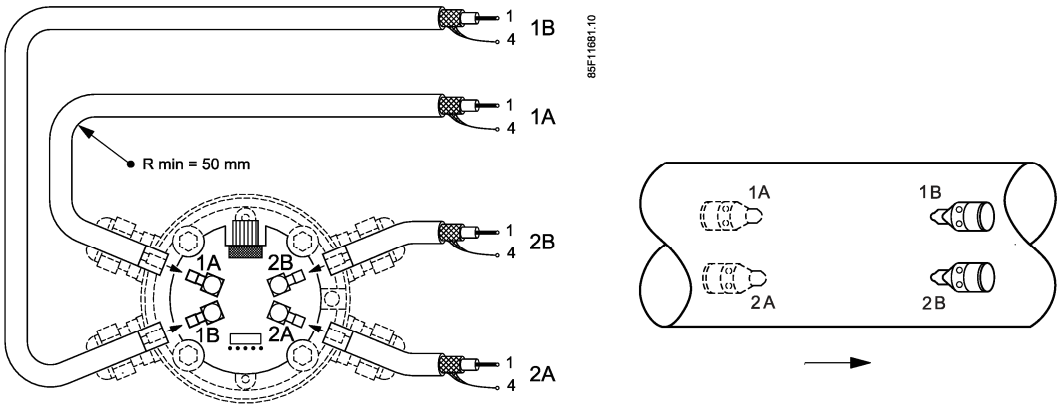
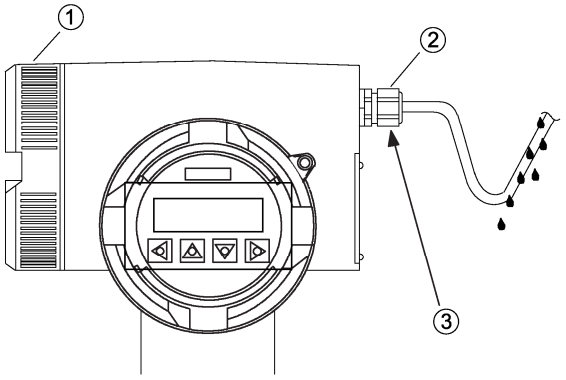


Figure 5-3 Wiring transducer cables, 2-path system

5.2 Wiring output and power supply

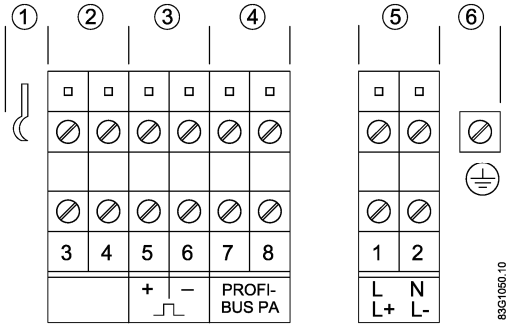


① Lid of terminal box
② Cable gland
③ PE connector - between the cable glands (please connect this PE connedtor)

Figure 5-4 FUS060 with lazed cables

1. Release the lid of the terminal box by turning the 3 mm hexagon socket screw
2. Unscrew the lid.
3. Push the power cable and signal cable through the cable glands up to the terminal block.

4. Make the connection according to the following schematics.



① Ground connection shield
② Terminals 3 and 4 are not used
③ Digital output 1 (active / passive)
④ PROFIBUS PA output
⑤ Power supply:
- L/N = 115 to 230 VAC
- L+/L- = 19 to 30 VDC / 21 to 26 VAC

⑥ Terminal for PE conductor

Figure 5-5 Connection schematics FUS060 PROFIBUS PA

NOTICE

Potential eqalization

The FUS060 enclosure must be connected with an earth wire to the PE connector, which is between the cable glands.

It is recommended that both transmitter and sensor are potential equalized via PE terminals for optimal performance.

Note

- Use signal cables with shielded wire pairs if analog output and pulse/frequency output are to be used simultaneously and signals are transmitted in one cable.
- For full performance at 10 KHz frequency on digital output 1, the capacitive load should not exceed 100 nF (see also technical specification for digital output 1).

5. Fit end ferrules to fine wire cables.
6. Connect PE cable of power supply to earth terminal in terminal box. Use a cable length so that the PE conductor is the last one to come away when the cables are pulled.
7. Tighten the cable glands and check strain relief.
8. Lay cables in a bend in front of the cable glands to prevent moisture getting into terminal block.
9. Screw the lid tightly on to the housing by using a tool. The sealing ring must be clean and undamaged.
10. Remount the lid lock.

5.3 Wiring PROFIBUS PA

Terminals 7 and 8 are reserved for the PROFIBUS PA connection. The PA interface is polarity independent, so the wires can be connected arbitrarily.

- 7: PA wire 1. This device is polarity independent
- 8: PA wire 2. This device is polarity independent

To achieve the best EMC performance, the unshielded wires should be as short as possible, 2-3 cm. Shield coverage of 90% is ideal.

⚠ CAUTION
Protection from electromagnetic interference It is recommended to use shielded twin core cables for connecting PROFIBUS PA to the transmitter.

Connection topologies

PA supports LINE, DROP, STAR topology and a combination of the three.

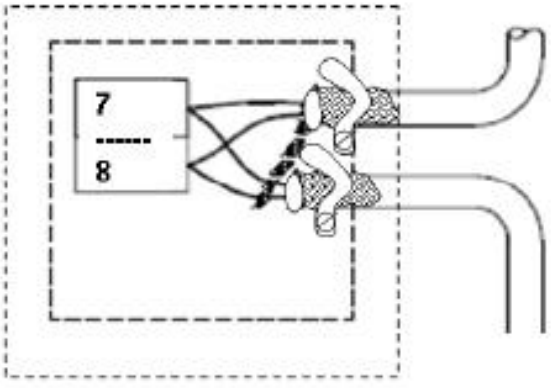


Figure 5-6 Electrical wiring

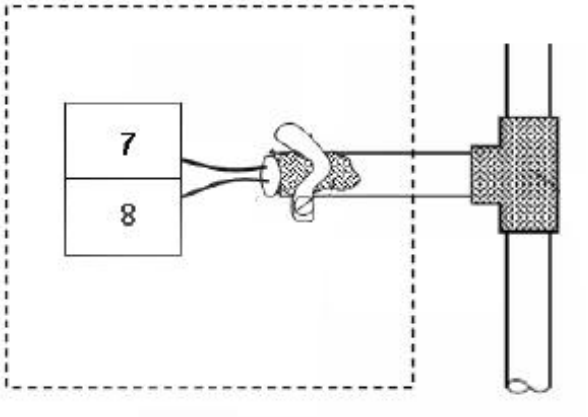


Figure 5-7 Electrical wiring with external T-connector

A maximum of 32 field devices may be connected per fieldbus segment (cf. IEC 61158-2 (MBP)). However, this number may be restricted due to type of ignition protection, bus power option, current consumption of field device etc.

A maximum of four field devices can be connected to a spur.

Wiring

- Install bus terminations at each end of the cable (Terminations are not included in the scope of delivery).
  With various junction boxes (not Ex-rated), the bus termination can be activated via a switch. Otherwise a separate bus terminator must be installed.

Note

If the fieldbus is extended with a repeater, the extension must also be terminated at both ends.

If the bus segment is branched, the device furthest from the segment connector represents the end of the bus.

- Connect shielding with the nearest reference ground.

⚠ CAUTION

Bus shielding

The specified immunity and radiated emission are only guaranteed if the bus shielding is fully effective. This includes connecting the shields to the metal connections of the device but also laying the shields to the terminal compartment, distributor, DP/PA coupler or DP/PA link.

⚠ CAUTION

Potential equalization

A suitable potential equalizer must be provided to avoid potential differences between the individual plant parts and thus the risk of malfunctioning. Refer to EN 60364-4-41 & EN 60364-5-54.

Installation check

- Make sure that the installation guidelines provided by the "Wiring & Installation Application Guide" on the PROFIBUS website are followed
- Make sure the wiring requirements for the device are met.
- Make sure that all connectors are properly tightened.

Commissioning 6

⚠ WARNING

Dangerous high voltage

Certain parts inside the device carry dangerous high voltage. The housing must be closed and grounded before switching the device on.

⚠ WARNING

Operation with high pressure and corrosive media

The sensor connected to this device can be operated with high pressure and corrosive media. Therefore improper handling of the device can lead to serious injuries and/or considerable material damage.

6.1 Start up

Upon power-on the device runs a self-test which lasts about 30 seconds. Immediately after the self-test, the device is ready for operation. Be aware that a number of factory settings (for example max. volume flow, angle of paths, distance between transducers, and displacement of transducer from center line of pipe) are dimension dependent. The settings are stored from factory in the transmitter for SONO 3100 and SONO 3300. For SONOKIT and spare part transmitters, enter values manually; see Keying in sensor data (Page 65). If there is still gas/air in the pipe (metering tube) or in the pipeline after assembly, a flashing "F" or "D" can appear at the top right of the first line in the display, see Diagnostics (menu 2) (Page 45) and Table 9-1 Error symptoms (Page 67). The failure signal is output at the output.

6.2 Operating the device

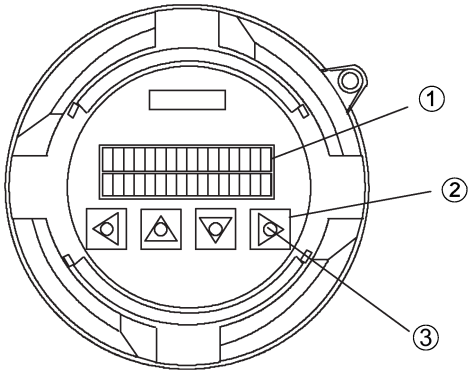
The device can be operated in the following ways:

- Local display (LUI)
- PROFIBUS PA
- SIMATIC PDM (PC/laptop)

6.3 Commissioning via local user interface

6.3.1 Operating via local display

The device is operated with the optical keypad on the operating and display panel. The keypad are operated by touching the appropriate fields on the glass panel with your fingertips. The individual device functions/parameters are selected and changed by alternately actuating the optical keypad with the menu-guided operation in the display.



① Display (LCD) - 2 lines of 16 characters
② Optical keypad
③ Infrared key

Figure 6-1 Keypad and display layout

For settings options for the automatic backlight function, see menu 1.1.5.

Note

IP protection

Operation does not require opening of the device. This means that a high degree of protection is guaranteed at all times.

6.3.2 Operating via PROFIBUS communication

The device can be operated via a PROFIBUS system based on the PROFIBUS PA communication protocol, see Figure 3-5 PROFIBUS PA architecture (Page 17).

BUS addresses

Make sure the PROFIBUS device addresses are set before operating two or more field devices on the bus. Every address may only be assigned once so that there is no confusion. Basically, an address range of 1 to 125 is possible; address 126 is set in the as-delivered state. Usually, the lower addresses are assigned to the masters in PROFIBUS systems. Therefore, we recommend starting the address for the device at 30. The addresses are set with the operation and monitoring module in menu 4.1.1 or a cyclically use of PROFIBUS.

Note

Change bus address

The BUS address can only be changed if there is no cyclical communication and all acyclic connections are closed.

6.3.3 Navigating the menu

The device functions and parameters available are shown in the second line of the display.

- Selection is made with the △ and ▽ keys. These are shown in the second line of the display.
- Enter device function or setting level of parameters with the ▷ key (Enter function).
- Exit the selected function or setting level without storage of the change by using the ◁ key until the cursor key moves to the far left position.

Changing parameter settings

The currently valid setting appears after selecting the setting level of a parameter. If programming is enabled, the programmable value flashes in the second line of the display. The parameter setting can be changed. There are two different types of data input:

- Direct numerical input
- Input from given table

In the numerical input, the ◁ and ▷ keys function as cursor control. The selected digit flashes.

The △ key increases the flashing digit (for example 9 **9** . 0 0 0 becomes 1 0 **0** . 0 0 0).

The ▽ key decreases the flashing digit (for example 1 **0** . 0 0 0 becomes **9** . 0 0 0).

The decimal point is moved to the right using the △ key and to the left using the ▽ key.

After selecting the last digit, the input is confirmed by using the ▷ key. The entered value is accepted if it is within the permissible input range. In this case the user guidance returns to the selection menu for the parameters of the group concerned. If the entered value is rejected, an error message briefly appears on the display followed by the previous setting. The value can be changed again.

When switching between different units a rounding-off may need to be corrected manually.

Note

If the ⏃ or ⏄ keys are operated permanently (finger left on the glass panel), the numeric value or setting option is changed continuously in tabular selection.

If an accidentally changed setting is wrong, it is possible to exit the menu item by pressing the ⏅ key several times (return to the menu one level up).

6.3.4 Write protection

Programming of the device by unauthorized persons can be prevented by using a personal, freely selectable code (not "0") in the operating and display panel. Device functions and parameters can then only be changed after entering the code. The personal code is set in the menu 6.2 Customer code.

If the ⏃ and ⏄ keys are actuated in the parameter setting level, the request to enter the code appears in the display. For free access, it is also possible to enter the code once in menu 6.1 Enter code.

The programming is disabled again:

- After returning to the display mode
- About 10 minutes after actuating the last optical keypad
- After entering any number, not the personal code, in menu 6.1 Enter code

Note

The programming is permanently enabled with code = 0 (factory setting).

See also

The exact structure of the operating menu is explained in the appendix Menu structure (Page 95). The main functions are described in Functions (Page 43).

6.3.5 Operating examples

The operating paths to be followed are represented in each diagram.

The optical keypads to be actuated are specified and the individual operating steps numbered consecutively.

Example 1 - Setting of menu language

Starting point is the multi-display

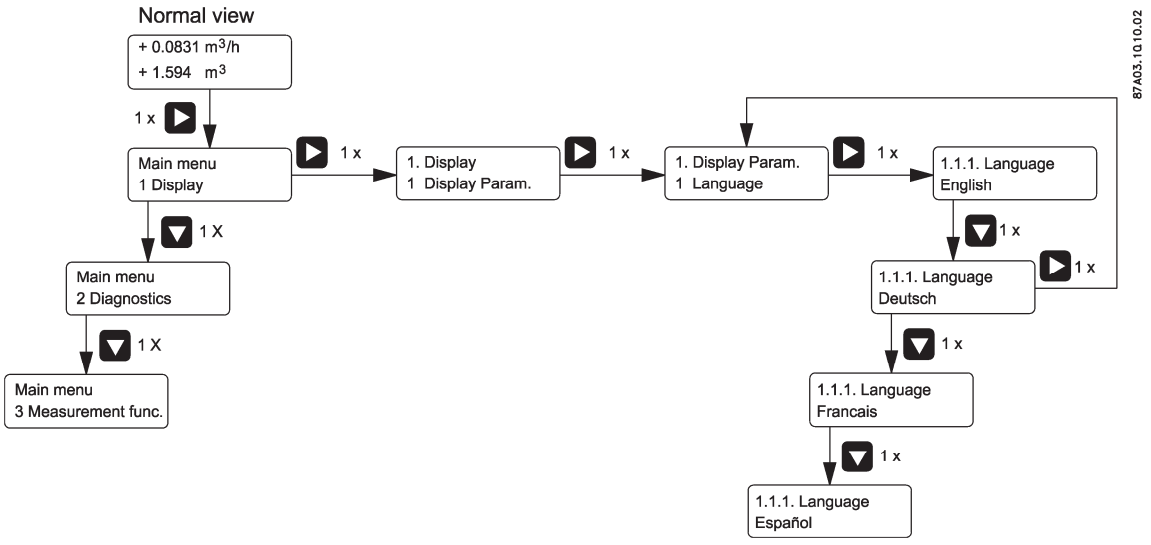


Figure 6-2 Changing language from factory-set "English" to "German (Deutsch)"

Example 2 – Setting of Bus Address

Starting point is the multi-display.

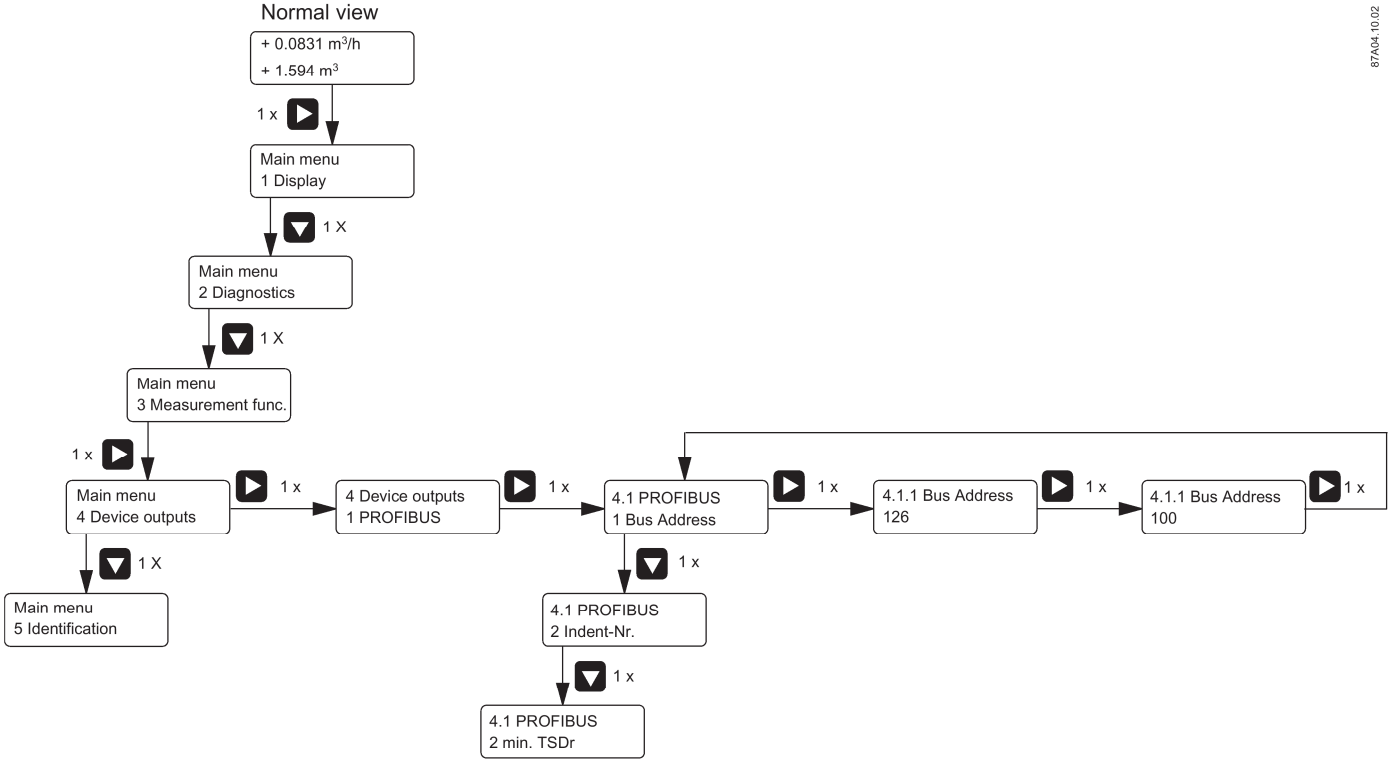


Figure 6-3 Changing the bus address from "126" to "100" (setting option: 0 to 126)

Note

Please check the "Ident-Nr."

Profile specific: 0x8159 (default setting)
Manufacturer specific: 0x9741

Example 2 - Changing the flow value unit

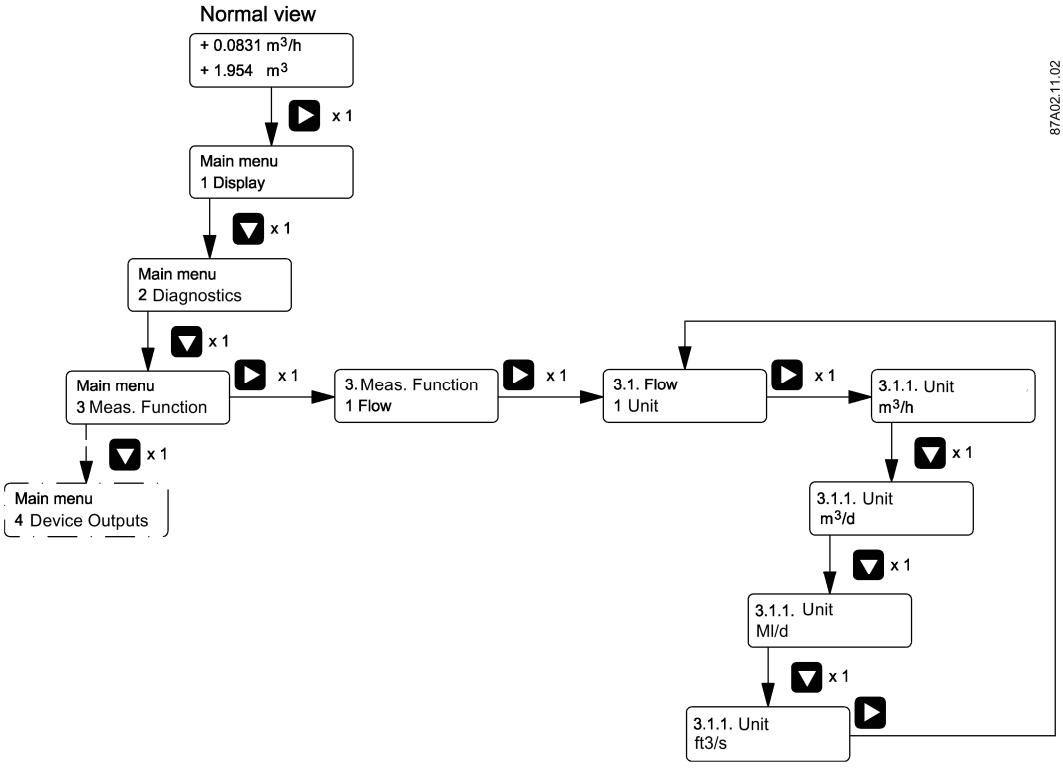
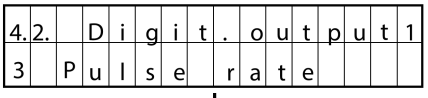


Figure 6-4 Changing the flow value unit from m^3/h to ft^3/s

Example 4 - Changing the pulse unit

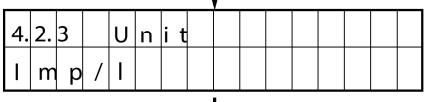
Starting point is the sub-menu 4.2.3 ("Pulse value")

The currently valid setting appears in the display.



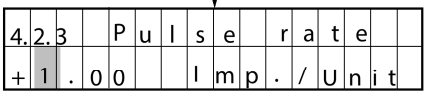
1 x

Enable the programming.
The unit in the second display line flashes.



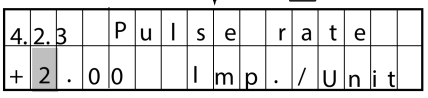
1 x

Digit 1 flashes.



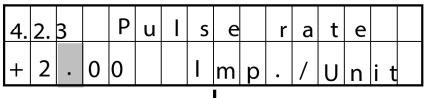
1 x

Change the digit from 1 to 2 with the operating element



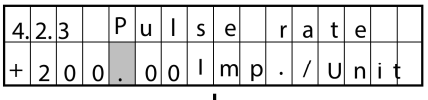
1 x

Select the point with the operating element.



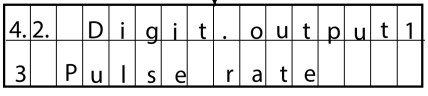
2 x

Move the point two places to the right by pressing the operating element twice.



3 x

Select the last position of the number with and terminate the input by pressing the operating element (Enter function).



6.4 Commissioning via PDM

SIMATIC PDM (Process Device Manager) is a software package for configuring, parameterizing, commissioning, and maintaining field devices (for example transducers). Among other features, SIMATIC PDM contains a simple process for monitoring process values, interrupts and status/diagnosis signals of a field device.

Note

Installation of SIMATIC PDM

For instructions on installation and operation of SIMATIC PDM, refer to the SIMATIC PDM Getting Started (included in the documentation package that comes with PDM).

Note

Supported SIMATIC PDM versions

The EDD supporting this product is compatible with SIMATIC PDM v. 6.0 + SP5 + HF5 through 8.0 + SP2.

6.4.1 Configuration

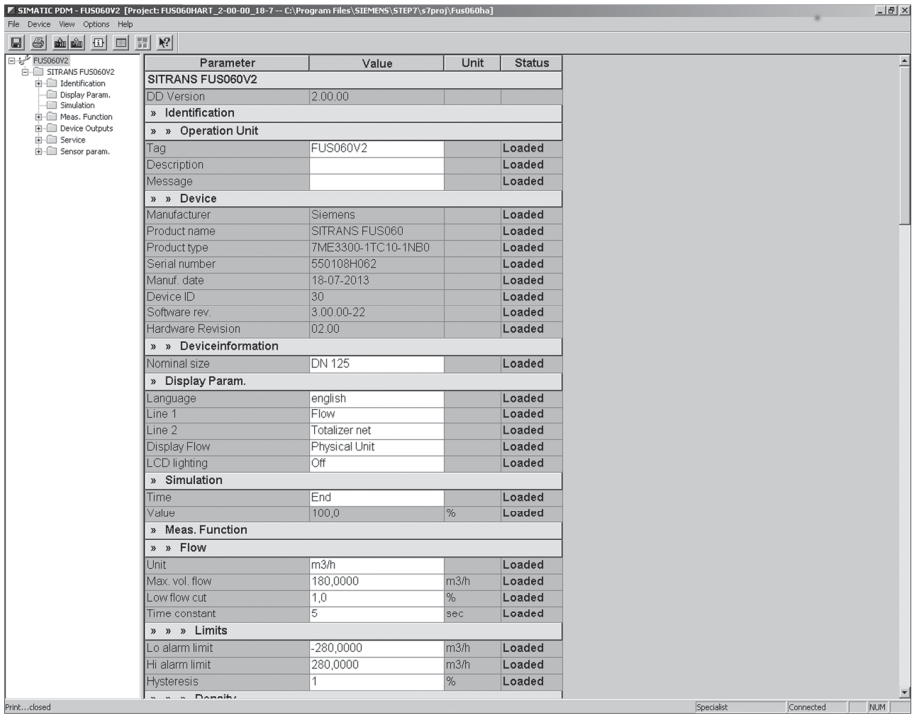


Figure 6-5 SIMATIC PDM (FUS060 HART example)

Note

Special characters

Some special characters are not supported via the SIMATIC PDM communication. In case of uploading such into the FUS060 a "?" is displayed instead. A "Ü" is changed to "ü" in the device display.

Commissioning steps

The commissioning is divided into the following steps:

1. Installing and connecting the device to the PROFIBUS system.
2. Installing the device driver (download from EDD download (http://support.automation.siemens.com/WW/view/en/24481552/133100)).
3. Adding the device to the SIMATIC PDM network.
4. Configuring the device.
5. Optimizing the system.
6. Checking the operation readiness.

Functions 7

Operation is based on a hierarchically structured operating concept. All functions/parameters are grouped logically and carry a menu number.

The seven main functions are selected in the main menu:

- Display (menu 1) (Page 43)
- Diagnostics (menu 2) (Page 45)
- Measuring functions (menu 3) (Page 46)
- Device outputs (menu 4) (Page 51)
- Identification (menu 5) (Page 55)
- Service (menu 6) (Page 56)
- Sensor parameters (menu 7) (Page 59)

The following section only describes how to manually operate the menus for the device settings.

7.1 Display (menu 1)

Language (menu 1.1.1)

Set display language (English, Deutsch, Francais, Español)

Line 1 (menu 1.1.2)

Set parameter value in line 1 (upper line on the display). Default is Flow.

Line 2 (menu 1.1.3)

Set parameter value in line 2 (lower line on the display). Default is Totalizer forward.

Display flow (menu 1.1.4)

Select the presentation of flow value (Physical Units (default), in % or Bar Diagramm (in %))

LCD lighting (menu 1.1.5)

Set the backlight turn-off. At power-off this function is automatically reset to the default value Off.

Off: At infrared key operation, the light turns on automatically and off again 10 minutes after last key action.

On: At infrared key operation, the light turns on automatically and stays on for 1 hour after last key action. Then it turns off.

Multi-Display (menu 1.1.6)

Shows the display with the settings done in menus 1.1.2, 1.1.3 and 1.1.4.

Flow (menu 1.2)

Shows the actual flow.

Totalizer (menu 1.3)

The actual totalizer readings are displayed with the correct sign, that is reverse totalizers with a minus sign. The three totalizers are shown in submenus 1.3.1, 1.3.2 and 1.3.3.

Settings (all) (menu 1.3.4)

Reset+stop: All quantity totalizers are set to "0" and stopped. The totalizer for the error count (menu 6.5.4) is set to "0" but not stopped.

Reset+start: All totalizers are set to "0" and started.

The totalizers can also be controlled individually (menus 3.4.3, 3.5.3 and 3.6.5).

Flow velocity (menu 1.4)

Actual average flow velocity in metering tube (in m/s)

Sound velocity (menu 1.5)

Actual sound velocity in medium (in m/s (default) or in ft/s)

Amplitude US (menu 1.6)

Relative ultrasonic amplitude of received ultrasonic signals (reference water) (in %)

Frequency and Current output (menus 1.7 and 1.8)

The arithmetically calculated output values are displayed in the menu 1.7 Frequency (in Hz) and in menu 1.8 Current Output (in mA), irrespective of whether the output is used.

7.2 Diagnostics (menu 2)

Device status (menu 2.1)

The test routines are systematically executed during normal operation. The error is indicated by a blinking letter on display:

D: Device error

F: Process error

The error can also be signaled on the analog and digital outputs.

The error is shown in menu 2.1 Device status. The error messages and their assignment to the blinking letter, the analog output and the digital outputs are listed in the table.

Table 7- 1 Error messages

Error message	Blinking letter on the display	Error message on	
		analog output	digital outputs 1 and 2 (relay)
Measuring path error	F	✓ 3)	✓
Unreliable flow value	F	✓ 3)	✓
P/F too high	F	✓ 3)	✓
US gain too high	F	✓ 3)	✓
COM module failure 1)	D	-	-
Measurement module failure	D	✓	✓
EEPROM failure	D	✓	✓
RAM failure	D	✓	✓
SSC failure 2)	D	-	✓
Firmware failure	D	✓	✓

1) HART module

2) Internal serial interface

3) Failure signal is not output if error is suppressed and simulation function is active

Suppress error (menu 2.2)

In this menu item the error(s) "Unreliab. Flow" and/or "Meas path err." can be suppressed so that the suppressed error(s) are not shown, neither on the display nor at the output. After every reset or power off of the device, all error messages are available again, thus this menu setting is not stored.

Device test (menu 2.3)

The following test sub routines are available:

Self test (menu 2.3.1)

The self test routines test the hardware and have a duration of about 10 seconds.

If there is no error, "OK" is displayed, otherwise "not OK". The type of error can be read in the menu 2.1 Device Status.

Display test (menu 2.3.2)

The LCD is checked with this menu item. The display is dark for about 5 seconds and then bright for about 5 seconds.

Simulation (menu 2.4)

The display and output values to be simulated can be selected in individual submenus. The setting becomes active after confirming the selected value. If an error is pending, only the display value can be simulated. The output will continue to indicate an error signal unless the errors are suppressed, see menu 2.2 Suppress err. (Both). The two warnings "P/F too high" and "US gain too high" do not influence the outputs during the simulation.

7.3 Measuring functions (menu 3)

Flow, Sound Velocity and Amplitude US (menus 3.1, 3.2 and 3.3)

In this menu the three measuring values Flow (menu 3.1), Sound Velocity (menu 3.2) and Amplitude US (menu 3.3) are parameterized.

All submenus (menu 3.x) are divided further for setting of subsequent values:

- Unit
- Range (Lower Value (for Flow not selectable - always 0) and Upper Value)
- Limits (Lo alarm limit, Hi alarm limit and Hysteresis)
- Time constant (damping)

Note

When switching between different units a rounding-off may need to be corrected manually.

Density (menu 3.1.4)

After entering units the display will automatically step into Density.

The density unit and value entered in this menu are used to convert the volume flow to mass flow (see also menu 3.1.1 Unit).

Note

Input of density is unnecessary and ineffective when volume flow unit has been selected in menu 3.1.1 Unit.

Flow direct (menu 3.1.5.1)

In this menu the setting of the main flow direction can be changed.

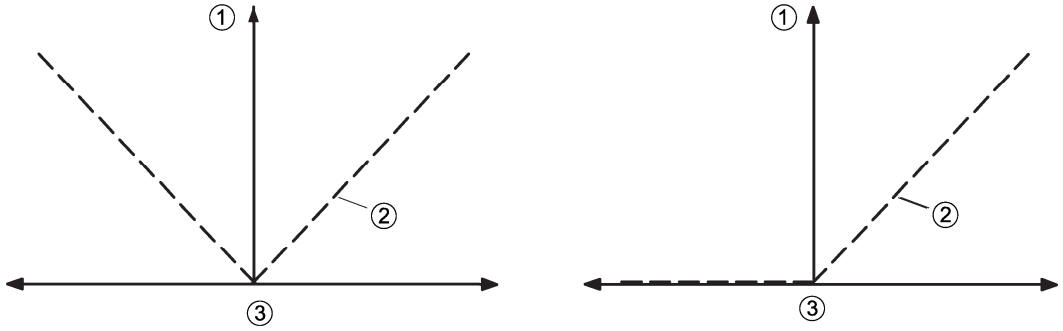
Meas. direct (menu 3.1.5.2)

The device is able to measure in both flow directions (forward and reverse) or in forward direction only.

The possible settings are:

- Forward + reverse
- Forward only

If "Forward only" is selected, signals are output or accumulated internally for a flow in this direction only.



Left figure: Forward and reverse flow. Right figure: Forward flow only

① Output signal
② Pulse/frequency output
③ Flow

Hysteresis (menus 3.1.5.3, 3.2.3.3, 3.3.2.3 and 3.6.4)

Signaling of measured values can operate with a hysteresis set by the user. The setting is made in % of full scale value (Max. vol. flow; menu 3.1.2). The setting range is 0 to 20 % of full scale value with a default value of 1 %.

Example 1:

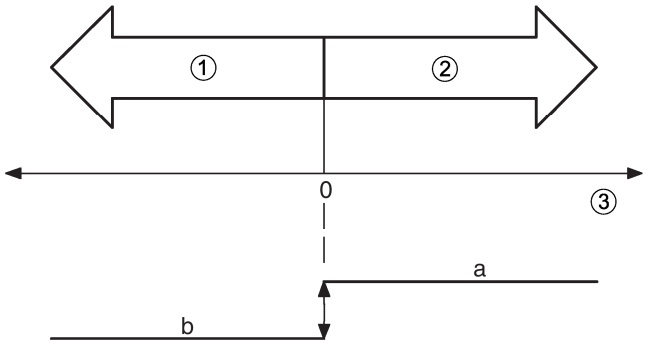
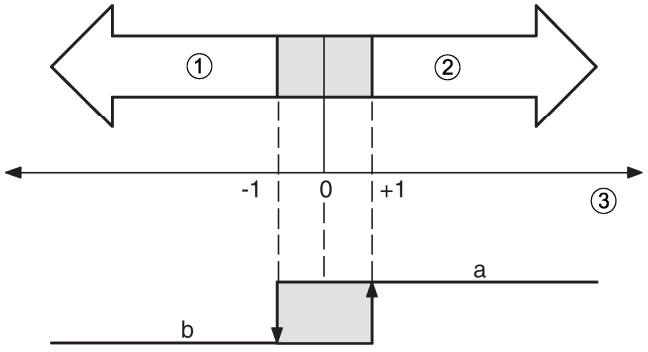
Hysteresis = 0 %
Digital output 1 = flow direction
Flow direction = forward
The output signal switches when the flow switches to reverse flow.

Example 2:

Hysteresis = 1 %
Digital output 1 = flow direction
Flow direction = forward
The output signal switches when the flow is -1 % of full scale value and switches back when the flow is +1 % of full scale value.

If the output is set to pulse/frequency output, the output will be in an inactive state while the flow is within the hysteresis range.

The function of the digital output 1 is set in menu 4.2.1, and the operating principle (output signal type) is set in menu 4.2.2.

Example 1: Hysteresis = 0 %	**Example 2:** Hysteresis = 1 %
	

①	Reverse
②	Forward
③	Flow in % of range

Selected setting	a/b	Output function
Passive-pos	a	Active (forward flow)
	b	Inactive (reverse flow)
Passive-neg	a	Inactive (reverse flow)
	b	Active (forward flow)

The other hysteresis menus are of the same principle.

Note

The low flow cut-off suppression has no influence on the signaling of the flow direction.

Low Flow Cut (menu 3.1.6)

The residual flow is an absolute value in flow units and is not automatically converted when the scaling changes.

Scaling (menus 3.1.x, 3.2.x and 3.3.x)

According to the PROFIBUS PA profile there are no selectable measuring ranges for process devices only sensor limits. Valid measured values (status "good") are always inside the following sensor size depending limits. The flow limits correspond with a flow velocity of 12 m/s and are automatically converted into kg/h for mass flow using the set density (menu 3.1.4); Sound velocity: 200 to 2000 m/s (menu 3.2) ; Ultrasonic amplitude: 1 to 150 % (menu 3.3).

Measured values outside the sensor limits are displayed but are no longer within the specified range. "uncertain, nonspecific, low limited" or "uncertain, nonspecific, high limited" will be signaled in the measured value status (Table 4-6, see above).

The physical measured values can be converted with a linear representation function according to Figure 5-1 to user-specific output values. A physical measuring scale with lower value, upper value and appropriate unit should be selected for this. This measuring scale is represented linearly on an output scale which is also defined with a lower value, upper value and appropriate unit.

All measured values are converted linearly into output values according to this scale even if they are outside the scale ranges.

Note

If a user-specific scale is not required, the measuring scale and output scale must be set identically (e.g. factory setting). The position and size of the scale ranges do not have any influence. The output values will then be identical to the physical measured values. The upper value on the output scale for flow is also the reference value for the upper frequency on digital output 1 (menu 4.2.5, chapter below). The lower value = 0 should be selected for the output scale to obtain a sensible assignment between the flow and frequency. The flow display in % (menu 1.1.4) is also related to the output scale.

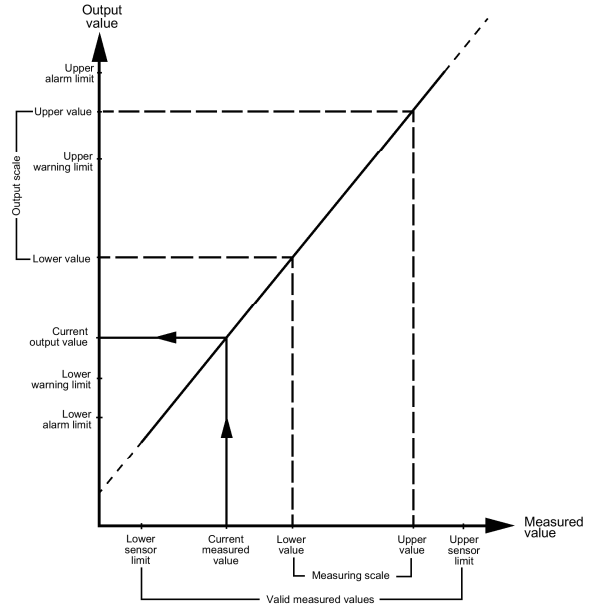
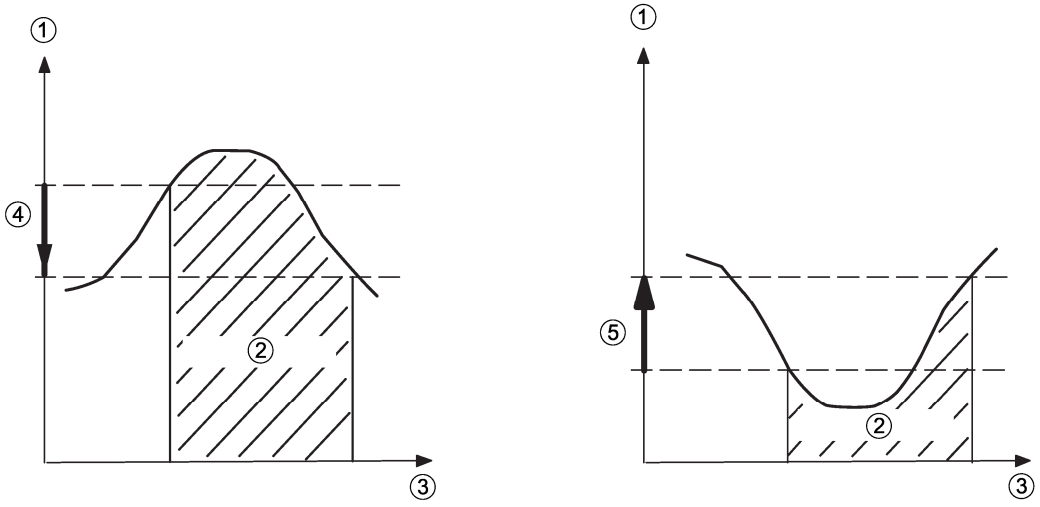


Figure 7-1 Assignment between measured value

Limit values for measured variables (menus 3.1.3, 3.2.3 and 3.3.2)

Limit values and hysteresis are related to the output scale; the hysteresis is an absolute value and is independent of scaling changes.



① Measured variable
② Limit alarm
③ Time
④ Hysteresis - limit max.
⑤ Hysteresis - limit - min.

Figure 7-2 Effect of hysteresis

Values exceeding or undershooting limits will be indicated in the measured value status ("Limits", chapter above). "active advisory alarm" warning limits and "alarm critical alarm" alarm limits are signaled in the substatus when they occur. The limit bits and alarm status are only removed when the measured value undershoots the affected limit in the opposite direction again by the value of the set hysteresis.

Totalizer (menus 3.4, 3.5 and 3.6)

The totalizers have fixed counting direction settings. The counting direction cannot be changed. The totalizers directly accumulate the physical measured values according to the negative or positive sign, that is the reverse totalizer only accepts negative values.

The reading of the net totalizer is accumulated from the flow values with the correct sign and is not calculated from the difference of the values of the forward and reverse totalizer. If individual totalizers are not reset or started at the same time, the reading on the net totalizer may deviate from the difference between the forward and reverse totalizer values.

Set Totalizer (menus 3.4.3, 3.5.3, 3.6.3 and 1.3.4)

"Stop+Reset":The selected totalizer is stopped and set to "0".

The totalizer remains stopped and may have to be restarted.

"Start": The selected totalizer is started.

Totalizers can also be preset to lower values <>0 (PRESET_TOT parameter) using PROFIBUS.

All totalizers can be set at the same time in menu 1.3.4.

Units for totalizers (menus 3.4.1, 3.5.1 and 3.6.1)

The units can be entered separately for each totalizer. When there is a switchover between mass and volume flow (by switching between massflow unit and volumeflow unit in menu 3.1.4), the totalizer readings will automatically be converted according to the density entered in menu 3.1.4. The unit is also automatically converted to the unit last set for the corresponding type (volume or mass).

Note

The selected display unit is also the unit on the fieldbus output. ("Transducer_Block" and "Function_Block" will have the same unit).

Limits (menus 3.4.2, 3.4.3, 3.5.2, 3.5.3, 3.6.2 and 3.6.3)

The same instructions apply to limits with quantity totalizers as to the output scales (see above). Totalizer readings and assigned limit values should also be considered according to positive (Hi limit alarm value is greater than the Lo alarm limit value) or negative sign (Lo limit alarm value is greater than the Hi alarm limit value)!

The hysteresis is only evaluated with the net totalizer as value fluctuations are only possible there.

7.4 Device outputs (menu 4)

In these menus the two device outputs (PROFIBUS PA output and digital output 1) are parameterized.

The PROFIBUS PA output (terminals 7+ and 8-) can indicate flow, sound velocity and US-amplitude.

The digital output 1 (terminals 5+ and 6-) can indicate pulse, frequency, alarm, status and limits.

PROFIBUS (menu 4.1)

(Terminals 7+ and 8-)

In this menu the PROFIBUS address of the device can be set.

Bus Address (menu 4.1.1)

Any address in the range 1 to 125 is possible in principle. The master on the PROFIBUS recognizes that an address has not been specifically issued to this device from the factory setting 126. We recommend setting an address > 30 for SITRANS FUS060 as addresses below 30 are normally issued to masters. Each address on the PROFIBUS may only be issued once.

The address can only be changed if there is no cyclical communication and all acyclic connections are closed.

Ident-Nr. (menu 4.1.2)

Selection of "Profile spec." or "Manufact. Spec." ident number, determines which GSD file will be used.

Note

Correct Ident-Nr.

Select the correct "Ident-Nr." for the PROFIBUS communication in order to use the correct GSD file.
Manufacturer specific: For use of 0x8159.gsd file (default setting)
Profile specific: For use of 0x9741.gsd file

min Tsdr (menu 4.1.3)

In this parameter the master on the PROFIBUS sets the minimum waiting time (minimum station delay time of responder) which the SITRANS FUS060 PA slave has to observe before it answers a master telegram (unit: bit time = 32 µs (time for 1 bit at 31.25 kbit/s)). This parameter is read-only and has the default setting of 11 bits.

Digital outp 1 (menu 4.2)

(Terminals 5+ and 6-)

In this menu the output function (pulse, frequency or alarm/limits) is assigned and the signal type as well as the pulse/frequency parameters are set.

Depending on the selected function (menu 4.2.1) either the pulse value and pulse width (menus 4.2.3 and 4.2.4) or the full scale frequency (menu 4.2.5) settings will affect the output.

The digital output 1 can indicate flow (pulse or frequency) and some alarms/limits.

Function (menu 4.2.1)

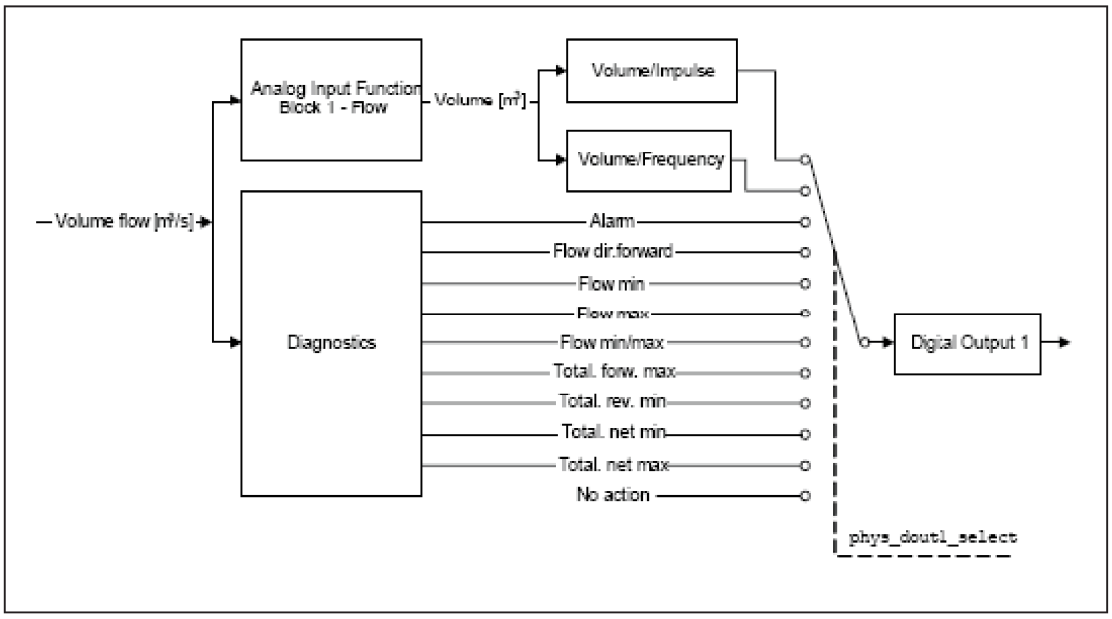


Figure 7-3 Function block diagram

In the "Pulse" and "Frequency" functions the flow is converted into a binary signal at the digital output:

In the "Pulse" function a pulse sequence corresponding with the forward net flow is issued. Each pulse corresponds to a net flow according to the set Pulse value (menu 4.2.3). The maximum number of pulses per time unit is reached with a flow to the extent of the upper value on the flow measuring scale (menu 3.1.2). Higher flow values can no longer be taken correctly into consideration at the pulse output. No pulses are issued when flow = 0.

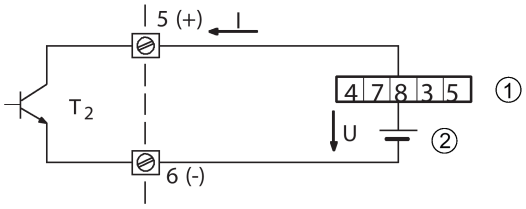
In the "Frequency" function a constant signal with a frequency proportional to the current flow value (output value) is issued. The frequency 0 corresponds to the lower value, the set upper frequency to the upper value of the output scale (menu 4.2.5). Flow values below the lower value are issued with the frequency 0.

If the flow exceeds the upper value on the measuring scale, the digital output can no longer correctly issue the required number of pulses or the frequency and a pulse/frequency error message ("P/F too high") will appear.

If the pulse/frequency error message appears, it is required to adjust the pulse settings (menus 4.2.3 and 4.2.4) or the full scale frequency (menu 4.2.5).

Signal type (menu 4.2.2)

In this menu the signal type of the digital output 1 can be configured. Only passive signals with selectable signal logic (positive or negative) are available for this output, i. e. the output acts as a switch and may have to be connected to an external supply (observe the current limit, see technical data Auto hotspot).

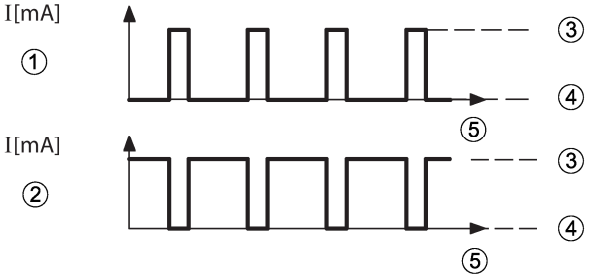


① Counter
② External supply

Figure 7-4 Passive signals

Signals with positive and negative logic can be generated (positive or negative pulses).

The figure below illustrates the setting options.



① Passive-positive
② Passive-negative
③ Transistor T_2 conductive
④ Transistor T_2 disabled
⑤ Time

Figure 7-5 Signal types for digital output 1

Pulse value (menu 4.2.3)

There are two parameters to be set for the pulse output in this menu:

- Unit
  The physical unit (unit/pulse).
- Pulse rate
  Number of mass/volume units per pulse.

Pulse width (menu 4.2.4)

This parameter is only required for the "Pulse" output function. You can set the pulse/pause ratio of the pulse output with the pulse width. The pulse width can be set in a range from 0.1 to 2000 ms. A maximum pulse width is calculated in relation to the set full scale value and the set pulse valence. The maximum pulse frequency is 5 kHz.

Full scale frq (menu 4.2.5)

The frequency is permanently assigned to the flow. The pulse/pause ratio is constant 1:1. If the "Frequency" function is selected, the "Full scale frq" is set in the range from 2 to 10 000 Hz.

7.5 Identification (menu 5)

In this menu the device-specific data can be entered or read.

Unit identity (menu 5.1)

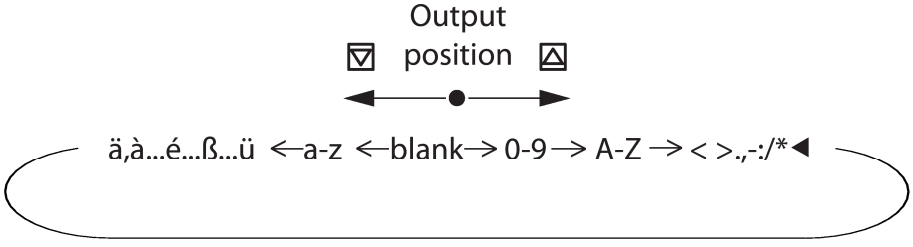
You can call or enter device-specific or TAG-related data in this menu.

You have the following options:

- TAG number, menu 5.1.1 (max. 8 characters)
- TAG description, menu 5.1.2 (max. 32 characters)
- TAG message, menu 5.1.3 (max. 32 characters)

TAG-specific data can be entered in these menus. The ▷ and ◁ keys function as cursor control. Numbers, letters and text characters are selected with the △ and ▽ keys.

If no text is stored, a "<" is displayed. By actuating the △ and ▽ keys, the "<" moves one position to the right and a character can be selected from the character set. The following characters are available:



The selected character is entered by actuating the ▷ key and the "<" flashes again. The next character can then be selected with the △ and ▽ keys. The text input is finalized by actuating the ▷ key when the "<" flashes.

For texts longer than 16 characters the marks < and > in the most left and/or the most right position of the display indicate that there are further characters to the left and/or right of the displayed text section. These are displayed by actuating the ▷ and ◁ keys.

You delete text by selecting the "<" from the character set with the ▷ and ◁ keys and then actuating the ▷ key. All inputs to the right of the end of text character are then deleted.

Note

Scrolling through the characters

If the △ and ▽ keys are actuated continuously (finger continuously touching the glass panel), the characters are automatically scrolled.

Manuf. Ident. (menu 5.2)

The product-specific identification data can be read in the following submenus:

- Product type (menu 5.2.1)
- Serial number (menu 5.2.2)
- Software rev. (menu 5.2.3)
- Manuf. date (menu 5.2.4)
- Nominal size (menu 5.2.5)

Note

Nominal size

The nominal pipe size is entered in menu 5.2.5. It is only a piece of information and has no influence on the measured values. It is not possible to change the nominal size without the factory code.

HART address (menu 5.3)

True identification of the HART device (not used for PROFIBUS communication).

7.6 Service (menu 6)

This menu offers service and diagnostics parameters for maintenance purpose.

Note

Backlight settings (LCD lighting)

Off: Light turns off 10 minutes after last key action.

On: On for 1 hour after last key action.

Enter code (menu 6.1)

Programming of the device by unauthorized persons can be prevented using a personal code (range 1 to 9999; max. four digits). By entering the correct code in this menu, the programming is enabled and the device settings can be changed (the general write protection must be disabled on the PROFIBUS (WRITE_LOCKING parameter).

If you have forgotten the code, enter 3333 in menu 6.1 and the personal code will be displayed for 5 seconds.

Customer Code (menu 6.2)

The four-digit personal code number can be created in this menu. The local write protection is activated for values > 0, that is menus can still be accessed but parameters cannot be changed.

The write protection is automatically enabled the next time the system is switched to the initial operating view.

Note

Attention

Programming is permanently enabled as long as the code is 0 and the general write protection is not enabled on the PROFIBUS (WRITE_LOCKING parameter)..

Service code (menu 6.3)

The calibration data and factory settings of the device are protected by a service code. The relevant menus are available only after entering this service code. For normal operation it is not required to enter the service code.

Reset (menu 6.4)

A reset of the unit can be made without change of parameters (warm restart). Totalizers are **not** reset.

Control values (menu 6.5)

In this menu, device-internal data used mainly for diagnosis for the used paths can be read.

The values displayed in the individual menu depend on the respective application (medium).

The following data are available:

- Gain
- Amplitudes
- Trigger level
- Error count %
- Time of flight - up (TOF up)
- Time of flight - down (TOF down)
- Difference in time of flight (delta TOF)

Gain (menu 6.5.1)

Every transducer gain level can be read.

These parameters are read only values and within the range of 0 to 255.

Unused paths will show 0. Normal values are in the range of 40 to 100. High gain values refer to a high sound absorption in the medium (maximum 255 for no sonic transfer, for example by empty pipe or if no sensor cable is connected).

Amplitudes (menu 6.5.2)

Each value shows the ultrasonic peak amplitude of the individual transducer in digital units from 0 to 255 corresponding to 0 to 5 V. Optimal values are between 95 and 100. Worst possible values are close to 0, for example by empty pipe or if no sensor cable is connected.

Trigger level (menu 6.5.3)

Each trigger level is used to recognize the ultrasonic signal. The trigger levels are calculated from the last signal level amplitudes. Typical values are between 40 and 100. Worst possible values are close to 128.

Error count % (menu 6.5.4)

The menu shows the error counter in % for each path. The optimal value is 0. Worst possible values are close to 100, for example by empty pipe or if no sensor cable is connected.

TOF up and TOF down (menus 6.5.5 and 6.5.6)

The time of flight (TOF) is the time in ns the ultrasonic signal takes to travel from one transducer to the other.

The time of flight is dependent on sensor size, angle, media, and temperature of the media.

Delta TOF (menu 6.5.7)

The time of flight difference is the measured difference in ps: TOF up – TOF down. The typical value is 1000 ps for a flow velocity of 0 m/s.

Zero Trim

In this menu a manual zero trim can be performed.

Note

Zero trim conditions

Zero trim should only be done at an absolute flowrate of zero.

7.7 Sensor parameters (menu 7)

In this menu the sensor-specific data is stored.

Note

Flowmeter systems with SONO 3100 or SONO 3300

All sensor characteristics in menu 7 are determined and preset at the factory. They should not be changed for flowmeter systems with sensor types SONO 3100 and SONO 3300.

Note

Flowmeter systems with SONOKIT

The FUS060 transmitter is preset at the factory according to the SONOKIT order codes (for example pipe dimension and number of paths). The exact sensor pipe dimensions based on the SONOKIT sensor geometry measurement report data must be entered in menu 7.

Sensor calibr. (menu 7.1)

In this menu various calibration data can be entered

Calibr. choice (menu 7.1.1)

The switching between WET and AUTO has a big influence on the calibration and the calculation of the flow value.

If WET is selected, the calibration parameters for SONO 3100 and SONO 3300 are taken from the factory calibration process. These parameters are stored in special WET calibration parameters.

If AUTO is selected, several sensor characteristics from the SONOKIT sensor geometry measurement report are combined and calculated to form the internal calibration factor. These calculated calibration factors for paths 1, 2, 3, and 4 are then read only parameters.

The calibration constants are based on the following SONOKIT sensor geometry measurement report data:

- Pipe diameter
- Length from transducer front to transducer front of every path
- Displacement of each sound path from center of pipe
- Average angle of every path
- Length of used cable in one sound path
- Roughness inside the pipe
- Viscosity of measured media

Note

Automatic calibration can only be used for ordinary round-shaped pipes.

Note

Always use **AUTO** calibration mode for flowmeter systems with **SONOKIT** sensors (menus 7.1.4.x.6 show the automatically calculated calibration factor).

Always use **WET** calibration mode for flowmeter systems with **SONO 3100** or **SONO 3300** sensors (menus 7.1.4.x.6 show the calibration factor, and menus 7.1.4.x.7 show the calculated flow).

App. param. (menu 7.1.2)

In this menu application-specific data can be entered.

Viscosity (menu 7.1.2.1)

The media viscosity value is used for the flow calculation and should only be changed for SONOKIT

The viscosity is default set to 0.01 cm^2/s (normal water).

Correct. fact. (menu 7.1.2.2)

This is a parameter that can be used to adjust the calculated flow.

Fl. offset comp. (menu 7.1.2.3)

The flow offset compensation (a constant positive or negative flow) can be added to the measured flow for service purposes.

Cablelen. TOFKOR (menu 7.1.2.4)

The transmitter is always installed in a remote position. Therefore it is necessary to enter the length of the sensor cable in order to compensate for the time delay occurring in the cables.

The cable length is the total length of the signal cable in one sound path. The measuring unit of the cable length is meters. The tolerance is ±0.5 m.

Pipe diameter (menu 7.1.3.1)

This value represents the average inside diameter of the actual pipe and should only be changed for SONOKIT.

Roughness (menu 7.1.3.2)

Roughness is the value for the inner pipe surface and should only be changed for SONOKIT.

The range of this value is 0.01 mm to 10.0 mm. The standard Siemens sensors have a roughness of approximately 0.4 mm.

Pipe material	Typical roughness
Smooth plastic pipe	0.1 mm
Polished stainless steel pipe	0.1 mm
Standard carbon steel pipe	0.4 mm
Rusty carbon steel pipe	1 to 2 mm
Concrete pipe	2 to 5 mm

Tracks (menu 7.1.4)

This menu consists of the parameters for the path settings and should only be changed for SONOKIT. In the following table only the parameters for path 1 are explained. The parameters for paths 2, 3 and 4 are to be handled equally.

Length (menu 7.1.4.1.1)

In this menu the distance between the ultrasonic transducers (path length, L) can be read and should only be changed for SONOKIT. The value is required in order to calculate the ultrasonic velocity from the time of flight and is found in the SONOKIT sensor geometry measurement report.

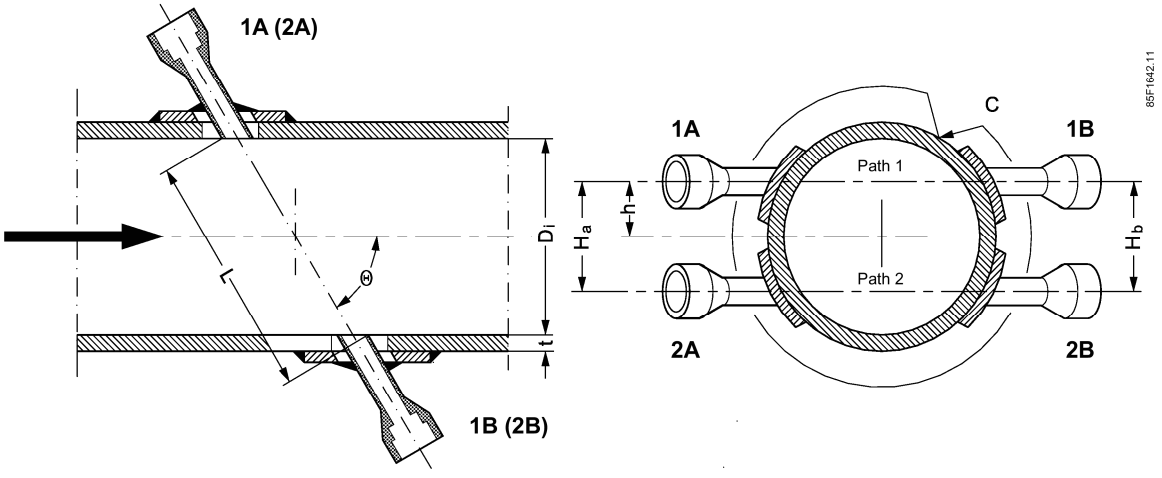


Figure 7-6 Sensor geometry data

Angle (menu 7.1.4.1.2)

In this menu the angle of each path (Θ in the figure above) can be read and should only be changed for SONOKIT.

Data for SONOKIT to be entered from the SONOKIT sensor geometry measurement report.

Displacement (menu 7.1.4.1.3)

In this menu the displacement for each path (h in the figure above) can be read and should only be changed for SONOKIT. "h" is the distance between the path and the center of the pipe.

Data for SONOKIT to be entered from the SONOKIT sensor geometry measurement report.

No. of tracks (menu 7.2)

In this menu the number of paths is set depending on the sensor design. The number of paths is preset from factory and can be changed to 1-path, 2-path, 3-path or 4-path. The number of paths should only be changed for SONOKIT.

Service and maintenance 8

8.1 Maintenance

The device is maintenance-free. However, a periodic inspection according to pertinent directives and regulations must be carried out.

An inspection can include check of:

- Ambient conditions
- Seal integrity of the process connections, cable entries, and cover screws
- Reliability of power supply, lightning protection, and grounds

NOTICE
Repair and service must be carried out by Siemens authorized personnel only.

Note

Siemens defines flow sensors as non-repairable products.

8.2 Technical support

If you have any technical questions about the device described in these Operating Instructions and do not find the right answers, you can contact Customer Support:

- Via the Internet using the **Support Request:**
  Support request (http://www.siemens.com/automation/support-request)
- Via Phone:
  - Europe: +49 (0)911 895 7222
  - America: +1 423 262 5710
  - Asia-Pacific: +86 10 6475 7575

Further information about our technical support is available on the Internet at
Technical support (http://support.automation.siemens.com/WW/view/en/16604318)

Service & Support on the Internet

In addition to our documentation, we offer a comprehensive knowledge base online on the Internet at:

Service and support (http://www.siemens.com/automation/service&support)

There you will find:

- The latest product information, FAQs, downloads, tips and tricks.
- Our newsletter, providing you with the latest information about your products.
- Our bulletin board, where users and specialists share their knowledge worldwide.
- You can find your local contact partner for Industry Automation and Drives Technologies in our partner database.
- Information about field service, repairs, spare parts and lots more under "Services."

Additional Support

Please contact your local Siemens representative and offices if you have additional questions about the device.

Find your local contact partner at: http://www.automation.siemens.com/partner

See also

Local contact person (http://www.automation.siemens.com/partner)

8.3 Return procedures

Enclose the delivery note, the cover note for return delivery and the declaration of decontamination form on the outside of the package in a well-fastened clear document pouch.

Required forms

- **Delivery Note**
- **Cover Note for Return Delivery** with the following information

  Cover note (http://support.automation.siemens.com/WW/view/en/16604370)
  - product (ordering number)
  - number of devices or spare parts returned
  - reason for the return
- **Declaration of Decontamination**

  Declaration of Decontamination (http://www.automation.siemens.com/w1/efiles/automation-technology/pi/Service/declaration_of_decontamination_en.pdf)

  With this declaration you certify *that the returned products/spare parts have been carefully cleaned and are free from any residues.*

  If the device has been operated together with toxic, caustic, flammable or water-damaging products, clean the device before return by rinsing or neutralizing. Ensure that

all cavities are free from dangerous substances. Then, double-check the device to ensure the cleaning is completed.

We shall not service a device or spare part unless the declaration of decontamination confirms proper decontamination of the device or spare part. Shipments without a declaration of decontamination shall be cleaned professionally at your expense before further proceeding.

You can find the forms on the Internet and on the CD delivered with the device.

8.4 Keying in sensor data

The following step-by-step procedure **only** applies to:

- FUS060 transmitters with SONOKIT sensors
- Replacement transmitters

NOTICE
SONO 3100 and SONO 3300 All FUS060 transmitters calibrated with sensors SONO 3100 or SONO 3300 are delivered with sensor data preset from factory. The data should not be changed

The step-by-step procedure describes the required parameters/data to be entered and the sequence of entering them in order to configure the transmitter correctly for a given pipe application.

Note

The pipe data are taken from the SONOKIT sensor geometry measurement report or from another sensor data sheet or calibration report.

Entering the data

1. Enter the sensor diameter (Di) (menu 7.1.3.1).

   Note

   If Di is smaller than registered, the setting in step 9 (displacement) must be changed first.

2. Choose appropriate engineering unit for flow (menu 3.1.1).
3. Enter maximum flow (menu 3.1.2).
4. Choose "AUTO" for calibration choice (menu 7.1.1).
5. Enter viscosity for media (menu 7.1.3.1), otherwise the default value (0.01 cm^2/s for water 20 °C) will be used.

6. Enter inside roughness of the sensor pipe (menu 7.1.3.2), otherwise the default value (0.4 mm) will be used.
7. Enter the measured transducer distance for each path (menus 7.1.4.x.1).
8. Enter the measured angle for each path (menus 7.1.4.x.2).
9. Enter the measured displacement for each path (menu 7.1.4.x.3). Enter 0 for paths not used.
10. Check the number of paths (menu 7.2). They are preset from factory according to order.
11. Go to service menu and check for each path that:
    - control values for amplitude (menus 6.5.2.x) have a value within the interval 95 to 105.
    - control values for error counters (menus 6.5.4.x) are 0.
    - control values for TOF (menus 6.5.5.x) are stable an only vary in the nanosecond range (for example ±10 ns).
12. Make sure that an absolute flowrate of zero is present and that the zero point adjustment procedure is activated via menu 6.6.3 Zero calibr..
13. Calculation of flow can be corrected by use of the customer correction factor (menu 7.1.2.2) which is a scaling factor.

Based on the entered data the transmitter is capable of measuring and calculating the actual flow. The accuracy of the system at this stage is dependent on for example the entered accuracy of the geometry data.

Troubleshooting/FAQs

9

9.1 Eliminating process errors

Only two general groups of errors are shown in the display: "Process error" and "Device error".

Device errors describe hardware errors, see Table 7-1 Error messages (Page 45).

Two main groups of process errors are:

- Measuring path error
  The medium in the measuring line is not permeable to sound; this applies both when the pipe is filled with gas or is empty. The measured value on the display is set to zero. Cable is broken or detached.
  The measured values have a very high dispersion so that errors in the measuring signal evaluation is indicated. It can be caused by disturbances in the flow pipe due to cavitation, twist or inhomogeneity such as bubbles or foreign bodies.
- Flow measurement unreliable
  The displayed measured values are not reliable and an "F" flashes in the right hand corner of the display.

Table 9- 1 Error symptoms

Symptoms	Diagnostics	Cause	Remedy
Display shows no flow, and/or a flashing "F" is displayed continuously/occasionally	• Error "Measurement path error" is pending • Gain (menus 6.5.1.X) for the active paths > 250 • TOF (menus 6.5.5.X and 6.5.6.X) for the active paths is not stable • Error counters (menus 6.5.4.X) are not equal to 0.	Pipe not filled with liquid	Make sure that the pipe is filled or at least the sound path is covered with liquid.
		Cable broken/detached	Make sure that the transducer cable is connected in the terminal housing of the transmitter. Make sure that the screen and center pin is connected inside the transducer top.
		Permanent disturbance inside the pipe	If possible, make sure that the transducer window inside the pipe is not damaged or that no permanent disturbance is present.

Symptoms	Diagnostics	Cause	Remedy
Flow not stable, and/or a flashing "F" is displayed continuously/occasionally	• Error "Measurement path error" is pending (menu 2.1) • Gain (menus 6.5.1.X) for the active paths > 250 • TOF (menus 6.5.5.X and 6.5.6.X) for the active paths is not stable • Error counters (menus 6.5.4.X) are not equal to 0.	Air bubbles or particles of any kind disturbing the measurement	Make sure that the pipe line is ventilated and that the concentration of particles is limited to a level at which normal measurement with the meter is possible.
		Cable partly connected	Make sure that the transducer cables are connected in the transmitter and in the sensors (SONO 3200 or SONO 3300). Check the connection of the cable screening. Make sure that the screen and center pin is connected inside the transducer top.
		Ultrasonic echoes	Make sure that the entered path lengths correspond to the measurement report.
Device displays negative flow, and/or a flashing "F" is displayed continuously/occasionally	-	Transducer cables incorrectly connected	Make sure that the transducer cables are connected correctly: 1A → 1A 1B → 1B 2A → 2A 2B → 2B
		Wrong setting of measurement direction	Make sure that the setting of menu 3.1.5.1 is "+ Direction"
Pulse/frequency output does not work, and/or a flashing "F" is displayed continuously/occasionally	Error "P/F too high" is pending (menu 2.1)	Internal electrical failure (open circuit, short circuit etc.)	Start simulation on the pulse/frequency output via menu 2.4. The frequency measuring instrument is coupled directly on the terminals.
		Pulse/pause or frequency out of range	Adjust pulse or frequency output settings (menu 4.2)
Device displays 0 flow. Device status: "OK"		Process flow value is very low compared with the low flow cut off limit of the device	For testing, check the low flow cut off (menu 3.1.6) is set to 0.
LCD display dark or partly dark (missing characters)		Internal electrical failure (open circuit, short circuit etc.)	Turn off power. Check the connections for the power supply PCBA and the flat cable for the display module. Start display test (menu 2.3.2.) in case of partly dark display.
Operation with infrared keys not possible		Light interference	Check that display is not dirty. Check that display lid is locked (PDM force control). Bright auxiliary tools may be of assistance.

9.2 Application information guide

In case the device needs service, the factory will typically request information about application and flowmeter.

Fill in this form and attach it to a Support request on:

Service and support

Note

Sketch

It is recommended to prepare a diagram/sketch of the installation/application explaining inlet and outlet conditions; distance from pump; etc.

To: **"Your local Siemens contact"**	**From:** **Company:** **E-mail:** **Phone no.:** **Fax no.:**

Liquid	Chemical formula:	
	Name of liquid:	
	Concentration:	
	Density:	
	Viscosity at 20 °C [mPa s]	
	Viscosity process temperature	
Flow measurement range		Typical limits:
Nominal size [m]		
Process temperature		+200 °C to –200 °C
Ambient temperature (transmitter)		–20 °C to +50 °C
Pressure		Max. PN 40
Gas/solid content		< 1 % / 3 %
Explosion protection		

Serial-No.	FUS060 nameplate	
System no.	FUS060 nameplate	
System S/N	FUS060 nameplate	
Order No.	FUS060 nameplate	
Software version	Menu 5.2.3 or FUS060 nameplate	
Device status, error message, frequency, ...	Menu 2.1	
Flow	Menu 1.4	
Flow velocity [m/s]		
Sound velocity $600 \leq c_{Medium} \leq 2000$	Menu 1.5	[m/s]
Ultrasonic amplitude	Menu 1.6	[%]

Frequency output	Menu 1.7	[Hz]
Upper range value for flow	Menu 3.1.2	
Low flow cut-off	Menu 3.1.6	
Flow damping	Menu 3.1.7	
PROFIBUS address	Menu 4.1.1	
Gain	Menu 6.5.1	(0 .... 255)
Amplitude	Menu 6.5.2	(0 .... 255)
Trigger level	Menu 6.5.3	(0 .... 255)
Error count	Menu 6.5.4	[%] (0 .... 100)
Time of flight up	Menu 6.5.5	[ns]
Time of flight down	Menu 6.5.6	[ns]
Delta TOF	Menu 6.5.7	[ps]

Technical data

10

10.1 SITRANS FUS060

Table 10- 1 Input

Input	
Measurement	Flow by measuring the transit time difference of ultrasonic signals through ultrasonic transducers in DN 100 to 4000 2-path sensor pipes (optional, depending on selected size, 1-path or 4-path special solutions are possible)
Nominal diameters and number of paths	2-pah DN 100 to DN 4000 (optionally also 1-path and 4-path, depending on size (DN 25 to DN 4000))
Max. cable length	120 m (395 ft) (shielded coaxial cable). For Ex version the transducer cable length is restricted to 3 m (9.84 ft) in order to meet requirements for electrical immunity. For 2-path and 4-path systems with sizes ≥ DN 3000 cable length is restricted to 30 m (98.4 ft).

Table 10- 2 Output

Output	
PROFIBUS PA output	
PROFIBUS PA interface	Layers 1 + 2 according to PROFIBUS PA
	Communication system according to IEC 1158-2
	Layer 7 (protocol layer) according to PROFIBUS DP, EN 50170 standard
Power supply	Separate supply, four-wire device
	Permissible bus voltage
	See certificates and approvals
Current consumption from bus	10 mA; ≤ 15 mA in event of error with electronic current limiting
Digital output 1	
Passive signal, can be configured with positive or negative logic	Open collector, 30 VDC, ≤ 200 mA Only passive signals for digital output 1
Output function, configurable for	**Pulse output**
	Adjustable pulse significance ≤ 5000 pulses/s
	Adjustable pulse width ³ 0.1 ms
	Frequency response
	fEND selectable up to 10 kHz
Function	Pulse, frequency, limits, device status, flow direction

Output				
Configuration conditions:				
Configuration	*Supply [V]*	*Load [Ω]*	*Current [mA]*	*Output voltage limits (max./min.) [V / mV]*
Passive - Pos	12	75	160	12 / 600
Passive - Neg.	12	75	160	12 / 600
Passive - Pos	12	520	23	12 / 100
Passive - Neg.	12	520	23	12 / 100
Passive - Pos	12	6.1 k	2	12 / 0
Passive - Neg.	12	6.1 k	2	12 / 0
Electrical isolation	Outputs electrically isolated from power supply and from each other (output isolation 63 VAC / 100 VDC to ground)			

Note

For full performance at 10 KHz frequency on digital output 1, the capacitive load should not exceed 100 nF.

Table 10- 3 Measuring accuracy

Measuring accuracy		
Accuracy (2-path)*		
	Pulse output	≤ ± (0.5...1.5) % of measured value at 0.5 m/s to 10 m/s
	(display, communication)	≤ ± (0.25....0.75) / V [m/s] % of measured value at flow < 0.5 m/s
	Repeatability	≤ ± 0.25% of measured value at 0.5 m/s to 10 m/s
Accuracy (1-path)*		
	Pulse output	≤ ± (1...3) % of measured value at 0.5 m/s to 10 m/s
	(display, communication)	≤ ± (0.5....1.5) / V [m/s] % of measured value at flow < 0.5 m/s
	Repeatability	≤ ± 0.25% of measured value at 0.5 m/s to 10 m/s

*Typically depending on accuracy of installation measurement

Table 10- 4 Reference conditions

Reference conditions	
Process temperature (sensor)	25 °C ± 5 °K (77 °F ± 9 °F)
Ambient temperature (transmitter and sensor)	25 °C ± 5 °K (77 °F ± 9 °F)
Installation conditions (sensor)	Upstream section > 10 x DN and downstream section > 5 x DN
Warming-up time	30 minutes

Table 10- 5 Rated operating conditions

Rated operating conditions	
Ambient temperature (transmitter and sensor)	-20...+50 °C (-4...+122 °F)
Storage temperature	-25...+80 °C (-13...+176 °F)
Enclosure rating	IP65 / NEMA 4
Electromagnetic compatibility	
Emission	For use in industrial environments
Immunity	EN 55011/CISPR-11
	EN 61326-1 (Industry); use of shielded output cables is recommended
Medium conditions	The measuring media must be ultrasonic signal compatible. It must be homogeneous and not two-phased to transfer the acoustic ultrasonic signals
Process temperature	-200 to +250 °C (-328 to +482 °F) (not directly influenced by medium temperature)
Gases/solids	Influence accuracy of measurement (approx. max. 3 % gases or solids)

Table 10- 6 Design

Design	
Transmitter (only as remote version)	Transmitter is connected to the transducers via 3 to 120 m (9.8 to 395 ft) long specially shielded cables (coaxial cable). For ATEX versions mounted in the Ex area only with 3 m (9.8 ft) long cables
Enclosure material	Die-cast aluminum, painted
Wall mounting bracket (standard and special)	Stainless steel (standard: always incl.)
Weight	4.4 kg (9.7 lb)
Cable glands	Power supply and outputs: 2 x M25 or 2 x M20 or 2 x ½" NPT Transducers/sensor: 2/4 x M16 or 2/4 x ½" NPT

Table 10- 7 Display and controls

Display and controls	
Display	LCD, two lines with 16 characters each (backlight)
Multi-display: 2 freely selectable values are displayed simultaneously in two lines	Volume flow, mass flow, volume, mass, flow velocity, sound velocity, ultrasonic signal information, frequency, alarm information
Operation	4 infrared keys Hierarchical menu shown with codes

Table 10- 8 Power supply

Power supply	
Supply voltage	
Standard version	120 to 230 V AC ± 15% (50/60 Hz) or 19 to 30 V DC/ 21 to 26 V AC
Ex version	19 to 30 V DC/ 21 to 26 V AC
Power failure	No effect for at least 1 period (> 20 ms)
Power consumption	Approx. 10 VA / 10 W

10.2 Cable specifications

Recommended cable types

It is recommended to use cable type A or B (cp. IEC 61158-2 (MBP)). Both types have cable shielding that guarantees adequate protection from electromagnetic interference and thus the most reliable data transfer. With cable type B more than one fieldbus (with the same degree of protection) may be operated in a cable. No other circuits are permissible in the same cable.

Table 10- 9 Recommended cable types

	Type A	Type B
Cable structure	Twisted pair, individual shield	Multiple twisted pairs, overall shield
Wire size	0.8 mm² (AWG 18)	0.32 mm² (AWG 22)
Loop resistance (DC)	44 Ω/km	112 Ω/km
Impedance at 31.25 kHz	100 Ω ± 20%	100 Ω ± 30%
Attenuation at 39 kHz	3 dB/km	5 dB/km
Capacitive asymmetry	2 nF/km	2 nF/km
Envelope delay distortion (7.9 to 39 kHz)	1.7 µs/km	*
Shield coverage	90%	*
Max. cable length (inc. spurs >1 m)	1900 m (6233 ft)	1200 m (3937 ft)

* not specified

Siemens provides a suitable cable for non-hazardous area with following order number - 6XV1 830-5BH10

Overall cable length

The overall cable length is made up of the length of the main cable and the length of all spurs (>1 m/3.28 ft).

The maximum network expansion depends on the type of ignition protection and the cable specifications.

Note

If repeaters are used the maximum allowed cable length is doubled. Max. three repeaters are permitted between user and master.

Spurs

The line between distribution box and field unit is described as a spur. By non-Ex applications the max. length of a spur depends on the number of spurs (>1 m/3.28 ft):

Number of spurs	1 to 12	13 to 14	15 to 18	19 to 24	25 to 32
Max. length per spur	120 m (393 ft)	90 m (295 ft)	60 m (196 ft)	30 m (98 ft)	-

10.3 Dimensional drawings

Dimensional drawings

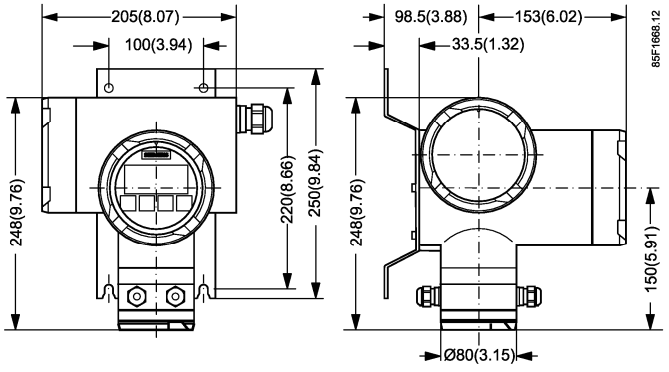


Figure 10-1 *FUS060 with standard mounting bracket.*

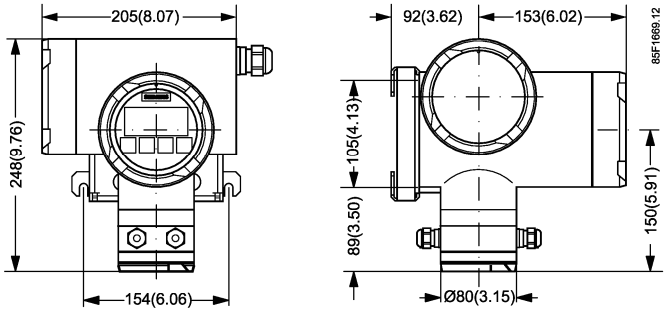


Figure 10-2 *FUS060 with the optional special mounting bracket.*

PROFIBUS communication

A

SITRANS FUS060 has a PROFIBUS PA connection compliant with IEC 1158 (synchronous transmission).

The only possible baud rate is 31.25 kbits/s. The min TSDR (smallest station delay time, see chapter below) at startup is 11 bit times and can subsequently be changed using the Set_Prm service. The bus address has the value 126 as-delivered and can either be changed with the Set_Slave_Add DP service or on the local keyboard (menu 4.1.1).

Communication uses the EN 50170 standard (PROFIBUS DP and DPV1). The data transmission and data formats will be described in the following sections.

DP services

The following DP services are supported as slave for a DP master class 1:

- Data_Exchange
- Rd_Inp
- Rd_Outp
- Set_Prm
- Chk_Cfg
- Slave_Diag
- Set_Slave_Add
- Global_Control
- Get_Cfg

DP V1 services

The following DVP1 services are supported as slave for a master class 2:

- MSAC2_Initiate (indication and response)
- MSAC2_Abort (request, indication and response)
- MSAC2_Read (indication and response)
- MSAC2_Write (indication and response)

A.1 Cyclic Data Transmission

Cyclic data transmission serves for fast exchange of process data between a class 1 master (control system or PLC) and the slave (SITRANS FUS060 with PROFIBUS PA).

Up to seven different measured values (= modules, Slots) can be transmitted cyclically as input data in a telegram with the Data_Exchange service.

The following measured values are available in the order specified:

Table A- 1 Cyclic data transmission, measured values

Slot No.	Parameter / measured value
1	Flow (volume or mass flow)
2	Sound velocity
3	Quantity (volume or mass) net
4	Ultrasonic amplitude
5	Quantity (volume or mass) forward
6	Quantity (volume or mass) reverse

Output data are sent to the device together with the cyclic request telegram. The number and type of actually transferred data can be determined with the aid of the configuration data (see GSD files (Page 87)).

A.2 Acyclic Data Transmission

The acyclic data transmission is mainly used for remote control of devices, i.e. for transmitting parameters during commissioning, maintenance, batch processes or for displaying variables which are not included in the cyclic process data traffic.

Acyclic accesses can be carried out by Master class 1 (C1 connection) or Master class 2 (C2 connection). SITRANS FUS060 PROFIBUS PA supports up to 4 simultaneous C2 connections.

The approximately 400 parameters including address (slot and index), format, value range, start value and attributes are stored in an object list "Obj8159.rtf" which will be provided on request.

Note

Acyclic operation with SIMATIC PDM

We recommend using the SIMATIC PDM software package and a PC (compatible with industry standard) or a programming unit for acyclic operation.

A.3 Input Data (from Slave to Master)

Input data are process data (measured values) which are transmitted from the device to the master in the following format:

Every measured value consists of 5 bytes which are composed of a floating point value corresponding with IEEE - 754 (4 bytes) and the correspondent measured value status (1 byte). In the PROFIBUS telegram, the measured value is transmitted first and then the corresponding status.

Table A- 2 Measured value formats

Byte	Bit							
No.	7 (MSB)	6	5	4	3	2	1	0 (LSB)
1	VZ	E 2^7	E 2^6	E 2^5	E 2^4	E 2^3	E 2^2	E 2^1
2	E 2^0	M 2^{-1}	M 2^{-2}	M 2^{-3}	M 2^{-4}	M 2^{-5}	M 2^{-6}	M 2^{-7}
3	M 2^{-8}	M 2^{-9}	M 2^{-10}	M 2^{-11}	M 2^{-12}	M 2^{-13}	M 2^{-14}	M 2^{-15}
4	M 2^{-16}	M 2^{-17}	M 2^{-18}	M 2^{-19}	M 2^{-20}	M 2^{-21}	M 2^{-22}	M 2^{-23}

VZ: sign: 0 positive, 1 negative E: Exponent M: Mantissa

A.4 Status bytes

Status bytes

The status bytes consist of three components:

- Quality (the MSBs 6 and 7):

  Describes the basic quality of the corresponding measured value
- Substatus (bits 2 to 5):

  Differentiates the quality of the corresponding measured value
- Limits (the LSBs 0 and 1):

  Indicate exceeding of the limit value

Table A- 3 Status byte formats

Byte	Bit							
No.	7 (MSB)	6	5	4	3	2	1	0 (LSB)
5	Quality		Substatus				Limits	

These components may adopt the following values in SITRANS F:

Table A- 4 Formats of the quality bits

Bit 7	Bit 6	Profile Designation	Meaning
0	0	bad	Measured value cannot be used
0	1	uncertain	Measured value uncertain
1	0	good (not cascade)	Measured value OK

Table A- 5 Formats of the substatus bits

Bit 5	Bit 4	Bit 3	Bit 2	Profile Designation	Meaning
0	0	0	1	configuration error	Parameter error, i.e. upper and lower value for measuring or output scale identical
0	0	1	1	device failure	RAM or EEPROM defective; Diagnostic bit "Memory error" is also set and the diagnosis message "RAM error" or "EEPROM error" displayed locally
				sensor failure	Measurement was not possible; Diagnostic bit "Memory error" is also set and the diagnosis message "Measuring path fault" displayed locally
0	1	1	1	out of service	Corresponding function block is in "Out of service" mode (see parameter "MODE_BLK actual")
0	0	0	0	non specific	Measurement contains too many implausible measured values, e.g. due to solids or gas bubbles in the medium. Diagnostic bit "Memory error" is also set and the diagnosis message "RAM error" or "EEPROM error" displayed locally
0	0	0	1	last usable value	Failsafe mode: the current measured value has been replaced with the last good measured value
0	0	1	0	substitute set	Failsafe mode: the current measured value has been replaced with the agreed failsafe value
0	1	0	0	initial value	Failsafe mode or state before the first measurement: the current measured value has been replaced with the start value
0	1	0	0	sensor conversion not accurate	Measured value is outside the sensor limits (Table 5-1, Page 30)
				O.K.	Measured value is OK (normal state)
0	0	0	1	update event	A parameter with the "static" memory attribute has been changed locally or on the PROFIBUS
0	0	1	0	active advisory alarm	Upper warning limit value has been exceeded or the lower warning limit value has been undershot below
0	0	1	1	active critical alarm	Upper alarm limit value has been exceeded or the lower alarm limit value has been undershot

Table A- 6 Formats of the limit bits

Bit 1	Bit 0	Profile Designation	Meaning
0	0	O.K.	The measured value is within the limit values (normal state)
0	1	low limited	The measured value has exceeded the upper limit (alarm, warning or sensor limit)
1	0	high limited	The measured value has exceeded the upper limit value (alarm, warning or sensor limit)
1	1	constant	Measured value remains constant

Note

Limit bits can only be clearly evaluated in combination with the quality information!

Status byte combinations

The following combinations of the values of the status bytes described above are possible in normal operation (i.e. when the input value of the function block concerned incl. status is not simulated:

Table A- 7 Valid combinations of the status byte

	Meaning substatus		applies to				
Value hex	quality		limits	flow	total net	total	total
1F	bad	out of service	constant	X			
0F	bad	device failure	constant	X			
0C	bad	device failure	O.K.		X	X	X
11	bad	sensor not connected	constant		X	X	X
07	bad	configuration error	constant	X	X	X	X
00	bad	non specific	O.K	X	X	X	X
52	uncertain	sensor conversion not accurate	high limited	X	X	X	X
51	uncertain	sensor conversion not accurate	low limited	X	X	X	X
4F	uncertain	initial value	constant	X			
4B	uncertain	substitute set	constant	X			
47	uncertain	last usable value	constant	X			
8E	good	active critical alarm	High limited	X	X	X	X
8D	good	active critical alarm	low limited	X	X	X	X
8A	good	active advisory alarm	high limited	X	X	X	X
89	good	active advisory alarm	low limited	X	X	X	X
84	good	active update event	O.K.	X	X	X	X
80	good	O.K.	O.K.	X	X	X	X

Note

The status conditions have decreasing priority from top to bottom. If several status conditions are fulfilled, the current status with the highest priority will be signaled.

A.5 Output Data (from Master to Slave)

The output data consist per totalizer (net, forwards and reverse) of one byte of which only the two LSBs respectively are evaluated. All other bits are not evaluated but should be set to 0 for safety. This value represents the "SET_TOT" parameter of the "Totalizer Function Block" defined in the PROFIBUS-PA profile.

Table A- 8 Totalizer mode "SET_TOT"

Bit 1	Bit 0	Profile description	Meaning
0	0	cancel	totalizer is running
0	1	reset	totalizer is stopped and reset to 0
1	0	preset	Totalizer is stopped and reset to a preset value (PRESET_TOT parameter, only acyclic access)

The transferred value is effective until it is changed, i.e. after the value 1 (reset totalizer) is sent, for example, the totalizer will remain on the value 0 until the SET_TOT parameter is changed again.

Each SET_TOT value affects the corresponding totalizer independently of the others. The quantities are also cumulated independently of each other, i.e. the net quantity does not have to be equal to the sum of the quantity forwards and quantity reverse especially if a totalizer has been reset or was preset.

A.6 Diagnostics

The diagnostic data can be requested with the Slave_Diag service. If extended diagnostic messages exist, this is displayed with the Diag_Flag of the Data_Exchange service. If the master then calls the Slave_Diag service, the user diagnostic data are supplied in the following form:

Table A- 9 Format of complete diagnostic data

Byte No.	Profile designation	Value	Meaning
1	Header	8 (dec.)	(fixed) length of diagnostic data (number of bytes)
2		254 (dec.)	(fixed)
3		1	(fixed)
4		0 or 1	or1 Display of changes in diagnostic data (see below)

Byte No.	Profile designation		Value	Meaning
5	Diagnosis	Byte 1	(s. below)	Diagnostic information
6		Byte 2	--	(not supported)
7		Byte 3	--	(reserved)
8		Byte 4	(s. below)	More diagnosis data is available

The total length of the external diagnostic data is always 8 including the header.

The Diag_Flag is always set when the last 4 bytes of the diagnostic data (corresponds with the DIAGNOSIS parameter) have changed since the last message therefore also, for example, when the diagnostic messages disappear again so that the master register each change in the diagnostic data.

If a diagnostic message is active, the corresponding bit is set or reset.

The following bits in the external diagnostic data are supported by SITRANS FUS060-PA all other bits always remain reset:

Table A- 10 Format of the diagnostic data, byte 4

Bit No.	Description	Meaning
0	Error appears	at least one bit of the following 4 bytes (DIAGNOSIS) has been set
1	reset	at least one bit of the following 4 bytes (DIAGNOSIS) has been reset
2 ... 7	reserved	---

Note

The "Error appears" message has priority over the "Error disappears", i.e. if a diagnostic bit is set and another reset at the same time, "Error appears" will be displayed.

The DIAGNOSIS part contains device diagnostic messages and has the following structure (bit 0 = LSB, bit 7 = MSB):

Table A- 11 Format of byte 5 diagnostic data (= DIAGNOSIS Byte 1)

Bit No.	Description	Meaning	Cause (local message)
0	DIA_HW_ELETR	Hardware failure of the electronic	"Temperature measurement error"
			"SSC error" Error in communication with internal peripherals
			"Communications module not addressable"
			"Measuring module not addressable"
4	DIA_MEM_CHKSUM	Memory error	"EEPROM error"
			"RAM error"

Bit No.	Description	Meaning	Cause (local message)
5	DIA_MEASUREMENT	Measurement failure	"Unreliable flow value"
			"Measuring path error" (affects flow, sound velocity and ultrasonic amplitude) This diagnostic message also appears when the measuring tube is empty!
			Flow outside sensor limits (not a local message)

Table A- 12 Format of diagnostic data, Byte 8 (DIAGNOSIS Byte 4)

Bit No.	Description	Meaning	Cause (local message)
0 ... 6	reserved	---	
7	EXTENSION_AVAILABLE	More diagnosis information is available	More diagnosis information available (see DIAGNOSIS--Byte 1 for local messages)

Format of byte 8 diagnostic data (= DIAGNOSIS Byte 4)

The bits in DIAGNOSIS take over the function of a collective message in most cases which can then be broken down in more detail using the local messages.

The EXTENSION_AVAILABLE bit indicates that there is further diagnostic information, essentially details on the DIAGNOSIS message. This information is displayed locally. The messages related to measured values are also transmitted with the measured values in the status byte (substatus).

Examples of telegrams with diagnostic data (Ext_Diag_Data)

Output state: all diagnostic bits are reset. When the "Temperature measurement error" (byte 5, bit 0 set) and "Unreliable flow value" (byte 5, bit 5 set) events occur, the following diagnostic data will result:

Diagnosis Byte No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Value (hex)	08	FE	01	01	20	00	00	80
Meaning	Header				Diagnosis			

Output state: all diagnostic bits are reset. When the "EEPROM error" (byte 5, bit 4 set) and "Flow outside sensor limits" (byte 5, bit 5 set) events occur, the following diagnostic data will result:

Diagnosis Byte No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Value (hex)	08	FE	01	01	30	00	00	80
Meaning	Header				Diagnosis			

Output state: at least one diagnostic bit is set. As soon as all diagnostic messages are removed the following diagnostic data result:

Diagnosis Byte No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Value (hex)	08	FE	01	02	00	00	00	80
Meaning	Header				Diagnosis			

A.7 Write Protection

General write protection can be enabled with the WRITE_LOCKING PROFIBUS parameter. This will then prevent any changes being made to parameters locally or using PROFIBUS.

- 0: General write protection enabled: Parameters cannot be edited. Exception: Output data for totalizers (set, start) when they are transmitted cyclically (with the data exchange service).
  This write protection can be disabled locally by entering the code "2457" (menu 6.1), when there is a continued communication failure.
- >0: General write protection disabled

Note

Parameter consistency between the device and control system is decisive for the correct interpretation of the cyclical measured values. During operation the local write protection (menu 6.2) or WRITE_LOCKING should therefore be enabled.

Hardware Write Protection

If write protection with hardware components is not set, the HW_WRITE_PROTECTION PROFIBUS parameter will not be of any significance.

Calibration data

Access to calibration data and special service parameters can only be enabled by entering a factory code. Improper changes to these data can cause the device to seriously malfunction.

Locking local operation

Local operation can be locked using the LOCAL_OP_ENABLE PROFIBUS parameter:

- 0: Local operation is disabled completely and the last valid display status remains. If communication fails for longer than 30 s, the local lock will be disabled automatically until communication is restored.
- 1: Local operation is enabled and if necessary limited with the WRITE_LOCKING write protection or a customer code.

A.8 Device Data Base File (GSD File)

The device data base file (GSD file) is used to configure the format and order of the cyclical data. The standard GSD for ultrasonic flow transducers described in profile 2.0 and which does not support manufacturer-specific expansions can be used alternatively to the device-specific GSD ("Si018159.gsd"). The "IDENT_NUMBER_SELECTOR acyclic parameter must be set to select the GSD.

IDENT_NUMBER_SELECTOR:

- 0 = profile GSD (0x9741.gsd)
- 1 = manufacturer-specific GSD (factory setting) (0x8159.gsd)

All permitted identifiers are listed in the GSD for each measured value (= module, Slots). They can be combined freely with the limitation that only one identifier can be used per module and the order of the identifiers must coincide with the order of the modules.

The identifier formats "short" (identifier byte) and "long" (extended identifier) are accepted for the flow, sound velocity and ultrasonic amplitude. The "long" and "resettable quantity ... long" are accepted for the totalizer modules. The identifiers are checked independently of each other, i.e. combinations with different formats are permitted when several measured values are queried. At least one measured value must be queried, i.e. the number of the identifier must be at least 1 and may be maximum 7.

The order of the measured values in the cyclical telegram defined in the GSD is set and cannot be changed.

For the configuration data this means that the first identifier always represents the flow, the second the sound velocity, ... , the last the quantity reverse. If you want to omit a measured value, set "Free Place" as the identifier.

Example

The measured values sound velocity, temperature and ultrasonic amplitude are to be transmitted. The following identifier combination should be set:

1. Free Place (for flow)
2. Short Identifier or long Identifier (for sound velocity)
3. Free Place (for net quantity)
4. Short Identifier or long Identifier (for ultrasonic amplitude)

An identifier is not required for the forward quantity and reverse quantity as the ultrasonic amplitude is the last value to be transmitted.

Output data can only be transmitted and therefore the totalizer reset if the corresponding "extended Identifier" (long) is used. The first byte of the output data always refers to the first resettable totalizer.

If, for example, the "Resettable quantity forw. (long)" and "Resettable quantity rev. (long)" identifiers for the forward and reverse quantity are set but the "Resettable quantity net (long)" identifier is not set for the net quantity, i.e. the net quantity totalizer is the only one which cannot be reset, the first byte of the output data will refer to the totalizer for the quantity forward.

A.9 GSD files

```
;***************************************************************************
***********
;**
**
;**               GSD Datei für SITRANS FUS060, SIEMENS AG
**
;**               MLFB: 7ME30**-*****-1***
**
;**               Stand: 11.08.2006
**
?? ;**               SIEM8159.GSD
**
;***************************************************************************
***********
#PROFIBUS_DP
GSD_Revision        = 3
Vendor_Name         = "SIEMENS AG"
Model_Name          = "SITRANS FUS060"
Revision            = "Revision 01"
Ident_Number        = 0x8159
Protocol_Ident      = 0
Station_Type        = 0
FMS_supp            = 0
Hardware_Release    = "September 2006"
Software_Release    = "September 2006"
Bitmap_Device       = "SIE8159n"
31.25_supp          = 1
45.45_supp          = 1
93.75_supp          = 1
MaxTsdr_31.25       = 100
MaxTsdr_45.45       = 250
MaxTsdr_93.75       = 1000
Redundancy          = 0
Repeater_Ctrl_Sig   = 0
24V_Pins            = 0
Freeze_Mode_supp    = 0
Sync_Mode_supp      = 0
Auto_Baud_supp      = 0
Set_Slave_Add_supp  = 1
Min_Slave_Intervall = 250
Modular_Station     = 1
Max_Module          = 6
Max_Input_Len       = 30
Max_Output_Len      = 3
Max_Data_Len        = 33
Fail_Safe           = 0
Slave_Family        = 12
```

```
Max_Diag_Data_Len   = 20
;----------- Description of device related diagnosis: --------------
-----------;
Unit_Diag_Bit(16)   = "Error appears"
Unit_Diag_Bit(17)   = "Error disappears"
Unit_Diag_Bit(24)   = "Hardware failure electronics"
Unit_Diag_Bit(25)   = "Hardware failure mechanics"
Unit_Diag_Bit(26)   = "Motor temperature too high"
Unit_Diag_Bit(27)   = "Electronic temperature too high"
Unit_Diag_Bit(28)   = "Memory error"
Unit_Diag_Bit(29)   = "Measurement failure"
Unit_Diag_Bit(30)   = "Device not initialized"
Unit_Diag_Bit(31)   = "Device initialization failed"
Unit_Diag_Bit(32)   = "Zero point error"
Unit_Diag_Bit(33)   = "Power supply failed"
Unit_Diag_Bit(34)   = "Configuration invalid"
Unit_Diag_Bit(35)   = "Restart"
Unit_Diag_Bit(36)   = "Coldstart"
Unit_Diag_Bit(37)   = "Maintenance required"
Unit_Diag_Bit(38)   = "Characteristics invalid"
Unit_Diag_Bit(39)   = "Ident_Number violation"
Unit_Diag_Bit(55)   = "Extension Available"
User_Prm_Data_Len = 0
;----------- Description of modules ---------------------------------
-----------;
; The mandatory modules order is defined at the end of the file by
Assignment of
; Modules using SlotDefinition Keyword.
;   Use exactly one identifier per module.
;   If you don´t want to get the measuring value of a certain module
from the
; device with the input data, use Free place for this module instead
of another
; identifier.
;
; For the modules of Flow, Sound Velocity and Sound Amplitude you
have the
; choice between these different identifiers:
;
; - Free Place
; - Short identifier format (identifier byte)
; - Long identifier format (extended identifier)
;
; For the modules Quantity net, Quantity forward and Quantity
reverse you have
; the choice between these different identifiers:
;
; - Free Place
; - Long identifier format (extended identifier)
; - Long identifier format, resettable (extended identifier)
;
; With the "resettable" format it is possible to reset the
totalizer,
; transmitting suitable output data to the device.
```

```
;------------------ Modules definitions ----------------------------
----------;

;-------------------------------------------------------------------
-----------
; Free place Module - usable for each module instead of another
identifier
;-------------------------------------------------------------------
-----------
Module = "Free place"                       0x00
1
EndModule

;-------------------------------------------------------------------
-----------
; Flow Modules
;-------------------------------------------------------------------
-----------
Module = "Flow (short)"                     0x94
2
EndModule

Module = "Flow (long)"                      0x42, 0x84, 0x08, 0x05
3
EndModule

;-------------------------------------------------------------------
-----------
; Sound velocity Modules
;-------------------------------------------------------------------
-----------
Module = "Sound velocity (short)"           0x94
4
EndModule

Module = "Sound velocity (long)"            0x42, 0x84, 0x08, 0x05
5
EndModule

;-------------------------------------------------------------------
-----------
; Quantity net Modules
;-------------------------------------------------------------------
-----------
Module = "Quantity net (long)"              0x41, 0x84, 0x85
6
EndModule

Module = "Resettable quantity net (long)"   0xC1, 0x80, 0x84, 0x85
7
EndModule

;-------------------------------------------------------------------
-----------
; Sound amplitude Modules
```

```
;-------------------------------------------------------------------
-----------
Module = "Sound amplitude (short)"          0x94
8
EndModule

Module = "Sound amplitude (long)"           0x42, 0x84, 0x08, 0x05
9
EndModule

;-------------------------------------------------------------------
-----------
; Quantity forward Modules
;-------------------------------------------------------------------
-----------
Module = "Quantity forward (long)"          0x41, 0x84, 0x85
10
EndModule

Module = "Resettable quant. forw. (long)"   0xC1, 0x80, 0x84, 0x85
11
EndModule

;-------------------------------------------------------------------
-----------
; Quantity reverse Modules
;-------------------------------------------------------------------
-----------
Module = "Quantity reverse (long)"          0x41, 0x84, 0x85
12
EndModule

Module = "Resettable quant. rev. (long)"    0xC1, 0x80, 0x84, 0x85
13
EndModule


;------------------- Assigments of Modules -------------------------
-----------
;

;-------------------------------------------------------------------
-----------
; Virtual Module assignment with plug in rules
;-------------------------------------------------------------------
-----------
SlotDefinition
SLOT(1) = "Flow" 2 1,2,3
SLOT(2) = "Sound velocity" 4 1,4,5
SLOT(3) = "Quantity net" 6 1,6,7
SLOT(4) = "Sound amplitude" 8 1,8,9
SLOT(5) = "Quantity forward" 10 1,10,11
SLOT(6) = "Quantity reverse" 12 1,12,13
EndSlotDefinition
```

A.10 FW revision history

FW revision	Date	Changes in FW	Changes in documentation
2.01.04	12.2005	First edition, PA profile version 2.00	New
2.01.07	01.2007	Signalling of update events in status byte	None

A.11 FW and GSD file compatibility

The PROFIBUS module provides backwards compatibility to earlier GSD files. This makes it possible to replace a module containing an earlier firmware version with a module containing the most recent firmware and still maintain compatibility to an already existing configuration through GSD files of a class 1 master.

A.12 Features supported by GSD files

The following table shows the features supported when combining compatible GSD files and FW versions of the PROFIBUS module.

GSD file	Compatible FW versions	Supported features
0x8159.gsd 0x9741.gsd	2.01.04 2.01.07 3.00.00	DPV0 and DVP1

PROFIBUS parameters

B

B.1 Parameter table

The parameter lists can be found in the objects list on the internet at: Flowdocumentation (http://www.siemens.com/flowdocumentation)

Menu structure

The graphic below only shows the main levels of the menu structure.

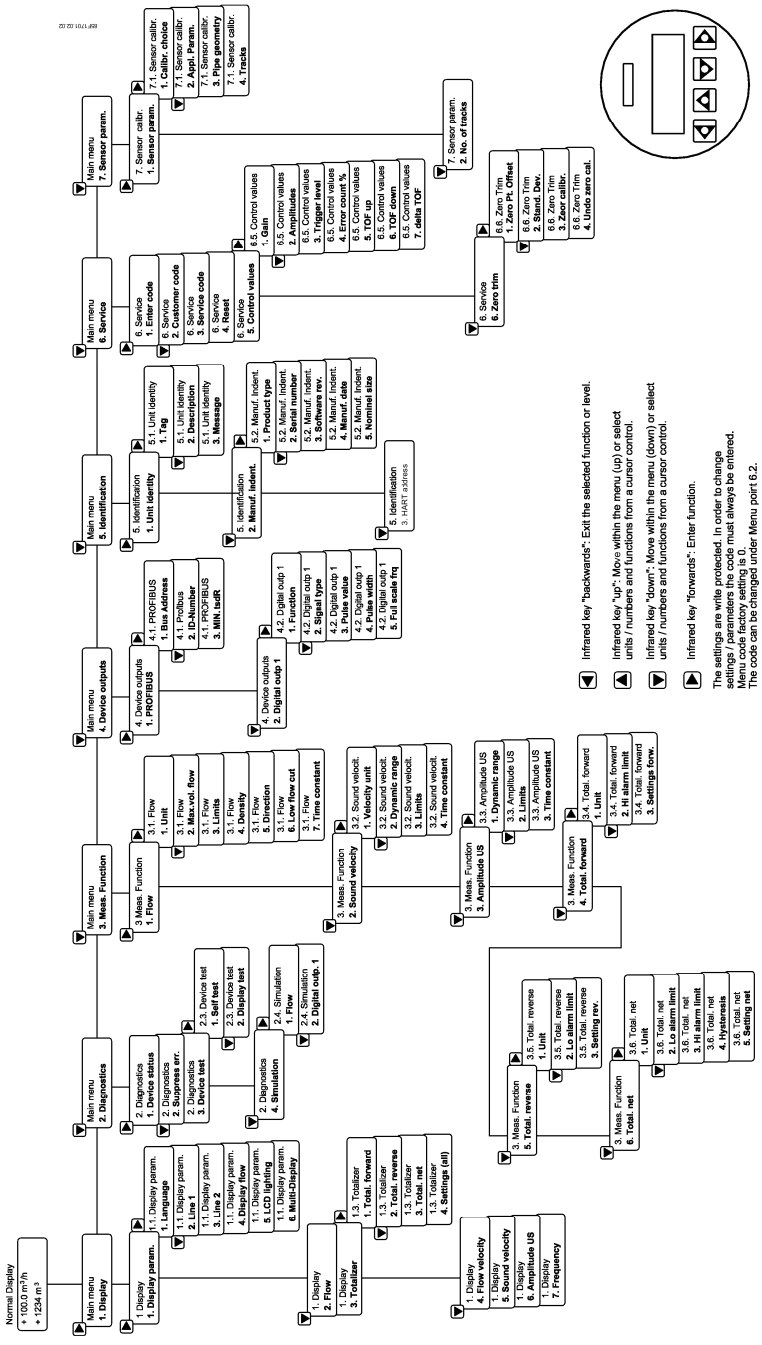


Figure C-1 Menu structure (main menus; FW 3.00.00)

Note

All menu items relevant for end users and simple service cases are listed in the following tables.

C.1 Menu items (SW Rev. 3.00.00)

The menu structure for local operation is based on the mandatory PROFIBUS PA block structure and therefore mostly repeated in the SIMATIC PDM PC user interface. The menu structure is therefore given in the table below.

Note

Only menu items relevant for end users and simple service cases are listed in this table.

Table C- 1 Menu 1: Display

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
1.1	Display parameter	Setting of actual display parameter readings			
1.1.1	Language	Language in display	English	english deutsch francais español	Write
1.1.2	Line 1	Parameter value in line 1	Flow	Flow Total. net Total. forward Total. reverse Flow velocity Sound velocity US-Amplitude Frequency	Write
1.1.3	Line 2	Parameter value in line 2	Total. net	Flow Total. net Total. forward Total. reverse Flow velocity Sound velocity US-Amplitude Frequency	Write
1.1.4	Display Flow	Select presentation	Physical Unit	Physical units % Diagram (Bar in %)	Write

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
1.1.5	LCD lighting	Switch LCD on/off (On at infrared key operation; automatically reset to Off at power-off)	Off	On (turns off automatically after 1 hour) Off (turns off automatically after 10 minutes)	Write
1.1.6	Multi display	Display of two measured values in lines 1 and 2	Line 1: Flow Line 2: Totalizer	See menu 1.1.2 See menu 1.1.3	Read
1.2	**Flow**				
1.2	Flow	Flow in metering tube	Actual metering value	For unit see menu 3.1.1	Read
1.3	**Totalizer**				
1.3.1	Total. forward	Totalizer forward	Actual value is shown	Units selectable in menu 3.4.1	Read
1.3.2	Total. reverse	Totalizer reverse	Actual value is shown	Units selectable in menu 3.5.1	Read
1.3.3	Total net	Totalizer difference Forward - reverse	Actual value is shown	Units selectable in menu 3.6.1	Read
1.3.4	Settings (all)	All totalizers will be set to zero. (Independent setting of totalizers in menu 3.4, 3.5, 3.6)	No action	No action Reset + stop Reset + start	Write
1.4	**Flow velocity**				
1.4	Flow velocity	Flow velocity in metering tube	Actual value is shown	m/s (range -12 to +12 m/s)	Read
1.5	**Sound velocity**				
1.5	Sound velocity	Sound velocity in medium	Actual value is shown	m/s	Read
1.6	**Amplitude US**				
1.6	Amplitude US	Relative ultrasonic amplitude of received ultrasonic signals (reference water). Depending on paths activated (up to 4 values).	Actual value is shown	Display in %	Read
1.7	**Frequency**				
1.7	Frequency	Frequency output value	Actual value is shown	Hz	Read

C.2 Menu 2 - Diagnostics

Table C- 2 Menu 2: Diagnostics

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
2.1	**Device status**				
2.1	Device status	Error messages are shown	"OK"	Only read See table in chapter 6.2	Read
2.2	Suppress error	Switch off error message	None	None Unreliable flow Measuring path disturbed Both	
2.2	Suppress error (not stored)				Write
2.3	**Device test**	Test device status	"OK"		
2.3.1	Self test	Visual LCD test			Read
2.3.2	Display test				Read
2.4	**Simulation**				
2.4.1	Flow Value Time	Simulation of flow. Simulation value. Affects all outputs and totalizers. Duration of simulation. After expiration of this time the normal measuring mode is resumed.	0% End (no action)	-110 to +110% End (no action) 0 min 30 min 60 min	Write
2.4.2	Digital output 1	Simulation of output signal	End (no simulation)	End (no simulation) 0.1 Hz 1 Hz 10 Hz 100 Hz 1 kHz 10 kHz Alarm on Alarm off	Write

C.3 Menu 3 - Measuring functions

Table C- 3 Menu 3, Meas. function

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
3.1	**Flow**				
3.1.1	Unit	Physical units for volume flow, mass flow Note: Whenever using mass flow - actual density have to be selected in menu 3.1.4	m^3/h	l/s, l/min, l/h, m3/s, m3/h, m3/d, Ml/d, ft3/s, ft3/min, ft3/d, gal/s, gal/min, gal/d, Mgal/d, ImpGal/s, ImpGal/min, Imp-Gal/d, g/s, g/min, g/h, kg/s, kg/min, kg/d, Ton/min, Ton/h, Ton/d, lb/s, lb/min, lb/h, lb/d, STon/min, STon/h, STon/d	
3.1.2	Max. vol. flow	Full scale value Note: Corresponds to 20 mA and selected max. frequency	Depends on sensor size	See dimension table in sensor manual	Write
3.1.3	Limits	Flow unit according to menu 3.1.1			
3.1.3.1	Lo alarm limit	Lower alarm limit (lower limit must be lower than upper limit)	Depends on sensor size	See dimension table in sensor manual	Write
3.1.3.2	Hi alarm limit	High alarm limit (higher limit must be higher than lower limit)	Depends on sensor size	See dimension table in sensor manual	Write
3.1.3.3	Hysteresis	Hysteresis for limit in % of full scale value	1%	0% to 20% of Max. vol. flow setting (menu 3.1.2)	Write
3.1.4.	Density Units	Density of media Density unit	kg/m^3	g/cm^3 g/l kg/l kg/m^3 lb/ft^3 lb/in^3 lb/gal lb/lmpgal	Write
	Density	Input of density value for arithmetic calculation of mass flow	+1000.00 kg/m^3	200 to 5000 kg/m^3	Write
3.1.5	Direction				
3.1.5.1	Direction	Determination of main direction of flow (forward direction)	+ Direction	+ Direction - Direction	Write
3.1.5.2	Measurement	Choice of measurement direction	Forward only	Forward only Forward + reverse	Write
3.1.5.3	Hysteresis	Setting hysteresis for flow direction related to full scale value	1%	0 to 20%	Write

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
3.1.6	Low flow cut	Determination of switching point for low flow cut-off. Suppression is related to full scale value	1%	0 to 20%	Write
3.1.7	Flow damping				
3.1.8	Time constant	Selection of time constants for measuring variables	5.0 sec	0.0 to 200 sec	Write
3.2	**Sound velocity**				
3.2.1	Dynamic range	Unit for sound velocity	m/s	m/s	Read
3.2.2	Dynamic range				
3.2.2.1	Lower value	Lower range value for sound velocity Lower range value < Upper range value	+600 m/s	+200 to 2000 m/s	Write
3.2.3	Limits				
3.2.3.1	Lo alarm limit	Lower alarm limit Lower alarm limit < Upper alarm limit	+200 m/s	200 to 2000 m/s	Write
3.2.3.2	High alarm limit	Upper alarm limit Upper alarm limit > Lower alarm limit	+2000 m/s	200 to 2000 m/s	Write
3.2.3.3	Hysteresis	Hysteresis for limit	5%	0 to 20%	Write
3.2.4	Time constant	Selection of time constant for measuring variable	5 s	0 to 200 s	Write
3.3	**Amplitude US**				
3.3.1	Dynamic range				
3.3.1.1	Lower value	Lower range value for ultrasonic amplitude Lower range value < Upper range value	1%	1 to 150%	Write
3.3.1.2	Upper value	Upper range value for ultrasonic amplitude Upper range value > Lower range value	100%	1 to 150%	Write
3.3.2	Limits				Read
3.3.2.1	Lo alarm limit	Lower alarm limit	1%	1% to 150%	Write
3.3.2.2	Hi alarm limit	Higher alarm limit	120%	1% to 150%	Write
3.3.2.3	Hysteresis	Hysteresis for limit	1%	0 to 20%	Write
3.3.3	Time Constant	Filter time constant	+10.00 s	0 to 200 s	Write

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
3.4	**Totalizer forward**				
3.4.1	Unit	Physical volume unit or mass unit. **Note:** Whenever using mass flow the actual density have to be selected in menu 3.1.4	m³	l, hl, m³, Ml, ft³, Gal, MGall, mpGal, MImpGal, g, kg, Ton, lb	Write
3.4.2	Hi alarm limit	Upper limit of alarm	+1.000.000.000 m³	0 to 1.000.000.000	Write
3.4.3	Setting forward	Volume totalizer reset to “0” and “stop/start”	No action	No action Reset + stop Reset + start	Write
3.5	**Total. reverse**				
3.5.1	Unit	Physical volume unit or mass unit **Note:** Whenever using mass flow the actual density have to be selected in menu 3.1.4	m³	l, hl, m³, Ml, ft³, Gal, M, Gall, mp, Gal, MImpGal, g, kg, Ton, lb	Write
3.5.2	Lo alarm limit	Vallue for lower limit of alarms	-1.000.000.000	-1.000.000.000 to 0	Write
3.5.3	Setting reverse	Volume totalizer reset to "0" and "stop/start"	No action	No action Reset + stop Reset + start	Write
3.6	**Forward - reverse volume**				
3.6.1	Total.net unit	Physical volume unit or mass unit **Note:** Whenever using mass flow the actual density have to be selected in menu 3.1.4	m³	l, hl, m³, Ml, ft³, Gal, MGal, ImpGal, MImpGal, g, kg, Ton, lb	Write
3.6.2	Lo Alarm Limit	Value for lower alarm limit	-1.000.000.000 m³	-1.000.000.000 o 0	Write
3.6.3	Hi Alarm Limit	Value for upper alarm limit	+1.000.000.000 m³	-0 to 1.000.000.000	Write
3.6.4	Hysteresis	Hysteresis for the limits	0	0 to 3	Write
3.6.5	Settings net	Volume totalizer reset to “0” and “stop/start”	No action	No action Reset + stop Reset + start	Write

C.4 Menu 4 - Device outputs

Table C- 4 Menu 4: Device outputs

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
4.1	**PROFIBUS**				
4.1.1	Bus Address	PROFIBUS address of device	126	0 to 126	Write
4.1.2	Ident-Nr	Selection of profile-specific or manufact.-specific identification number (GSD-files: manuf. 0x8159.gsd; profile 0x9741.gsd).	Manuf. spec.	Manuf. spec. Profile spec.	Write
4.1.3	min Tsdr	Minimum station delay time of responder (unit: bit time =32 µs = time for 1 bit at 31.25 kbit/s).	11 bits	Factory set (11 bits) Read only	Read
4.2	**Digital output 1**	**Frequency or impulse signal for flow or alarm signal**			
4.2.1	Function	Assignment of output function	Pulse	Pulse Frequency Alarm Flow dir. forward Flow min Flow max Flow min/max Total forw. max Total rev. min Total net. min Total net max No function	Write
4.2.2	Signal type	Configure output: Signal: passive only Logic: positive or negative	Passive-pos.	Passive-pos Passive-neg	Write
4.2.3	Pulse value				
	Unit	Physical unit per impulse (only necessary if "Pulse"is used)	m^3/Imp	l/Imp, m^3/Imp, Gal/Imp, ImpGal/Imp, kg/Imp, t/Imp, lb/Imp	Write
	Pulse rate	Number of volume units per impulse (only necessary if "Pulse"is used)	1 m^3/Imp	0 to 1000.0	Write
4.2.4	Pulse width	Setting pulse width (only necessary if "Frequency" is used)	0.10 ms	0.1 to 2000 ms	Write
4.2.5	Full scale freq.	Full scale frequency	10000 Hz	2 to 10 000 Hz	Write

C.5 Menu 5 - Identification

Table C- 5 Menu 5: Identification

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
5.1	**Unit identity**				
5.1.1	Tag	Tag number on metering unit	To be defined by user	HART: max 8 charac.	Write
5.1.2	Descriptor	Tag number description	To be defined by user	HART: max32 charac.	Write
5.1.3	Message	Messages to tag	To be defined by user	HART: max 32 charac.	Write
5.2	**Manuf. Ident.**				
5.2.1	Product type	Product type	Order number	Read only	Read
5.2.2	Serial number	Device serial number	Format: xxxxxxHwwy xxxxxx = number ww = production week y = production year	Factory set (up to max. 13 characters) Read only	Read
5.2.3	Software rev.	Software revision	3.00.00 (Previous 2.01.04 or 2.01.07)	Read only	Read
5.2.4	Manuf. date	Manufacturing date - DD.MM.YYYY		Read only	Read
5.2.5	Nominal size	Sensor size	Depending on diam-eter, only informal detail, no influence on measurements	Read only	Read
5.3	Device ID (HART adress)	True identification in HART long address (not relevant for PROFIBUS communication)	0	Factory set (0 to 15) Read only	Read

C.6 Menu 6 - Service

Table C- 6 Menu 6: Service

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
6.1	**Enter code**	Entering the 4 digit code selected in menu 6.2 in order to change user parameters	0	0 to 9999 According to setting in menu 6.2	Write
6.2	Customer Code	Selection of a personal code. Code 0: User parameter are not protected. Code>0: User parame-ters are protected under menu 6.	0	0 to 9999	Write

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
6.3	Service code	Only for service in the Siemens factory			Write
6.4	Reset	Re-start of unit without change of parameters	Cancel	Cancel Reset	Write
6.5	**Control values**				
6.5.1	Gain				
6.5.1.1	Gain up 1	Gain of first path up; optimal value: 40 to 100		0 to 255	Read
6.5.1.2	Gain dw 1	Gain of first path down; optimal value: 40 to 100		0 to 255	Read
6.5.1.3	Gain dw 2	Gain of second path up; optimal value: 40 to 100		0 to 255	Read
6.5.1.4	Gain up 2	Gain of second path down; optimal value: 40 to 100		0 to 255	Read
6.5.1.5	Gain dw 3	Gain of third path up		0 to 255	Read
6.5.1.6	Gain up 3	Gain of third path down		0 to 255	Read
6.5.1.7	Gain dw 4	Gain of fourth path up		0 to 255	Read
6.5.1.8	Gain up 4	Gain of fourth path down		0 to 255	Read
6.5.1.9	Gain limit	A warning level for application control and diagnostics purposes	Depends on ordered sensor size	1 to 255	Write
6.5.2	Amplitudes				
6.5.2.1	Ampl dw 1	Amplitude of first path up		0 to 255; optimum: 95 to 105	Read
6.5.2.2	Ampl dw 1	Amplitude of first path down		0 to 255; optimum: 95 to 105	Read
6.5.2.1	Ampl dw 2	Amplitude of first path up		0 to 255; optimum: 95 to 105	Read
6.5.2.2	Ampl dw 2	Amplitude of first path down		0 to 255; optimum: 95 to 105	Read
6.5.2.3	Ampl dw 3	Amplitude of first path up		0 to 255; optimum: 95 to 105	Read
6.5.2.4	Ampl dw 3	Amplitude of first path down		0 to 255; optimum: 95 to 105	Read
6.5.2.5	Ampl dw 4	Amplitude of first path up		0 to 255; optimum: 95 to 105	Read
6.5.2.6	Ampl dw 4	Amplitude of first path down		0 to 255; optimum: 95 to 105	Read
6.5.2.7	Ampl dw 2	Amplitude of first path up		0 to 255; optimum: 95 to 105	Read
6.5.2.8	Ampl dw 2	Amplitude of first path		0 to 255; optimum: 95 to 105	Read

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
6.5.3	Trigger/Level				
6.5.3.1	Trig up 1	Trigger-level of first path up		0 to 128; typical: 40 to 100	Read
6.5.3.2	Trig dw 1	Trigger-level of first path down		0 to 128; typical: 40 to 100	Read
6.5.3.3	Trig up 2	Trigger-level of second path up		0 to 128; typical: 40 to 100	Read
6.5.3.4	Trig dw 2	Trigger-level of first path down		0 to 128; typical: 40 to 100	Read
6.5.3.5	Trig up 3	Trigger-level of second path up		0 to 128; typical: 40 to 100	Read
6.5.3.6	Trig dw 3	Trigger-level of first path down		0 to 128; typical: 40 to 100	Read
6.5.3.7	Trig up 4	Trigger-level of second path up		0 to 128; typical: 40 to 100	Read
6.5.3.8	Trig dw 4	Trigger-level of first path down		0 to 128; typical: 40 to 100	Read
6.5.4	Error count %				
6.5.4.1	Error 1	Error totalizer in % for path 1		0-100% Optimal: 0%	Read
6.5.4.2	Error 2	Error totalizer in % for path 2		0-100% Optimal: 0%	Read
6.5.4.3	Error 3	Error totalizer in % for path 3		0-100% Optimal: 0%	Read
6.5.4.4	Error 4	Error totalizer in % for path 4		0-100% Optimal: 0%	Read
6.5.5	TOF up				
6.5.5.1	TOF up 1	TIME OF FLIGHT (TOF) of first path upstream		Value in ns	Read
6.5.5.2	TOF up 2	TIME OF FLIGHT (TOF) of second path upstream		Value in ns	Read
6.5.5.3	TOF up 3	TIME OF FLIGHT (TOF) of third path upstream		Value in ns	Read
6.5.5.4	TOF up 4	TIME OF FLIGHT (TOF) of fourth path upstream		Value in ns	Read
6.5.6	TOF down				
6.5.6.1	TOF down 1	TIME OF FLIGHT (TOF) of first path udowntream		Value in ns	Read
6.5.6.2	TOF down 2	TIME OF FLIGHT (TOF) of second path downstream		Value in ns	Read
6.5.6.3	TOF down 3	TIME OF FLIGHT (TOF) of third path downstream		Value in ns	Read
6.5.6.4	TOF down 4	TIME OF FLIGHT (TOF) of fourth path downstream		Value in ns	Read

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
6.5.7	Delta TOF	TIME OF FLIGHT (TOF) difference		Value in ns	Read
6.5.7.1	Delta TOF 1	TIME OF FLIGHT (TOF) difference of first path (up - down)		Value in ns	Read
6.5.7.2	Delta TOF 2	TIME OF FLIGHT (TOF) difference of second path (up - down)		Value in ns	Read
6.5.7.3	Delta TOF 3	TIME OF FLIGHT (TOF) difference of third path (up - down)		Value in ns	Read
6.5.7.4	Delta TOF 4	TIME OF FLIGHT (TOF) difference of fourth path (up - down)		Value in ns	Read
6.6	**Zero Trim**				
6.6.1	Zero Pt.Offset				
6.6.1.1	Zr.Pt.Offset 1	Zero offset of first path	Depends on factory calibration, for example +0.000 ns	-50.000 ns to +50.000 ns	Write
6.6.1.2	Zr.Pt.Offset 2	Zero offset of second path	Depends on factory calibration, for example +0.000 ns	-50.000 ns to +50.000 ns	Write
6.6.1.3	Zr.Pt.Offset 3	Zero offset of third path	Depends on factory calibration, for example +0.000 ns	-50.000 ns to +50.000 ns	Write
6.6.1.4	Zr.Pt.Offset 4	Zero offset of fourth path	Depends on factory calibration, for example +0.000 ns	-50.000 ns to +50.000 ns	Write
6.6.2	Stand.Dev.				
6.6.2.1	Stand.Dev. 1	Standard deviation for path 1		Typical: +0.000 ns	Read
6.6.2.2	Stand.Dev. 2	Standard deviation for path 2		Typical: +0.000 ns	Read
6.6.2.3	Stand.Dev. 3	Standard deviation for path 3		Typical: +0.000 ns	Read
6.6.2.4	Stand.Dev. 4	Standard deviation for path 4		Typical: +0.000 ns	Read
6.6.3	Zero Trim "Start sero tr."	Initiates a device specific adjustment cycle (zero trim processing) that determines the true zero point value. **Only during no-flow process conditions!**		Start Status is shown as: Running / Finished	Write
6.6.4	Undo zero tr.	Undo last zero trim		After choice shows "Zero Trim OK"	Write

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
6.7	Trim parameter				
6.7.1	Error Filter				
6.7.1.1	Val. uncertain	Error filter limit value uncertain (%) for the average quality of the ultrasonic measurement (signal pairs of up and down). Below this value the error status is set to uncertain and the warning is indicated (on display and output). The actual (maybe unstable) measured values are displayed	Depends on system configuration ordering, for example 50% for 2-path sensor system	1 %, 5 %, 10 %, 25 %, 50 %, 75 %, 90 %, 95 %, 99 %	Write
6.7.1.2	Value bad	Error filter value bad (%) with same function as descripted above. Additionally, the measured values are set to "0" in the display and the output signal to the error signal level	50 %	1 %, 5 %, 10 %, 25 %, 50 %, 75, %, 90 %, 95 %, 99 %, never	Write

C.7 Menu 7 - Sensor parameters

Table C- 7 Menu 7: Sensor Param.

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
7.1	Sensor calib				
7.1.1	Calib choice	Calibration choice	AUTO (SONOKIT systems) WET (SONO 3100 and SONO 3300 systems)	WET AUTO	Write
7.1.2	App. param.	Application parameters			
7.1.2.1	Viscosity	Viscosity of media (viscosity for water at 20 °C is 0.01 cm^2/s)	0.01 cm^2/s	0.005 to 5 cm^2/s (optional unit: in^2/s)	Write
7.1.2.2	Correct. fact.	Calibration factor compensation value for flow sensor to correct the measured values; typical 1.0	1.0	0.000001 to 100	Write
7.1.2.3	Fl. offset comp.	Offset compensation value for flow sensor (in flow unit) (in the menu 3.1.1 closed unit)	+0.00000 m^3/h	-max. flow to +max.flow (see menu 3.1.2)	Write
7.1.2.4	Cable len. TOFKOR	Total cable length for a path. All paths must have the same length	Depending on selection (factory setting with the ordered transducer cable length)	0 to 500 m	Write

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
7.1.3	Pipe geometry				
7.1.3.1	Pipe diameter				
7.1.3.1.1	Engr.unit	Unit selection (m or in)	m	m in	Write
7.1.3.1.2	Pipe diameter	Inside diameter of pipe (m or in)	Depending on selection at ordering	0.01 to 4.0 m	Write
7.1.3.2	Roughness				
7.1.3.2.1	Engr.unit	Unit selection (mm or in)	mm	mm in	Write
7.1.3.2.2	Roughness	Roughness of the inner pipe wall (mm or in); for example 0.04 m for steel pipes	0.4 mm (0.015748 in)	0.01 to 10.0 mm	Write
7.1.4	Tracks				
7.1.4.1	Track 1				
7.1.4.1.1	Length 1	Length of path 1 (m). The distance between the two ultrasonic transducers of path 1, see Figure 7-6 Sensor geometry data (Page 61).	Depending of sensor size selected at ordering	>0 to 8.0 m	Write
7.1.4.1.2	Angle 1	Angle of path 1	Depending of sensor size selected at ordering	0 to 89°	Write
7.1.4.1.3	Displacement 1	Displacement of path 1 (m) Note: The value must be smaller than the half entered pipe diameter (see menu 7.1.3.2.2). For 1-path the value must be set to 0	Depending of sensor size selected at ordering	0 to 1.5 m	Write
7.1.4.1.4	Trig. con 1 Up	The signal trigger constant of the first path up. Typically, values between -1.35 and +1.35 are useful; typical value is -0.75	Depending on ordered sensor system	-1.40 to +1.40	Write
7.1.4.1.5	Trig. con 1 Dw	The signal trigger constant of the first path down. Typically, values between -1.35 and +1.35 are useful; typical value is -0.75	Depending on ordered sensor system	-1.40 to +1.40	Write
7.1.4.1.6	AUTO cal. 1	The AUTO calibration factor is automatically calculated **Note:** Only shown if AUTO is selected in menu 7.1.1			Read
7.1.4.1.6	WET cal. 1	The WET calibration factor of the path. **Note:** Only shown if WET is selected in menu 7.1.1	Depending on factory calibration of the transmitter, which is typically done together with the ordered sensor	0.0000010 to 100.0000000 (value with 7 fractional digits)	Write

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
7.1.4.1.7	WET Flow 1	This value represents the calculated flow **Note:** Only shown if WET is selected in menu 7.1.1	Depending on factory calibration together with ordered sensor		Read
7.1.4.2	Track 2				
7.1.4.2.1	Length 2	Length of path 2 (m). The distance between the two ultrasonic transducers of path 2, see Figure 7-6 Sensor geometry data (Page 61).	Depending of sensor size selected at ordering	>0 to 8.0 m	Write
7.1.4.2.2	Angle 2	Angle of path 2	Depending of sensor size selected at ordering	0 to 89°	Write
7.1.4.2.3	Displacement 2	Displacement of path 2 (m) Note: The value must be smaller than the half entered pipe diameter (see menu 7.1.3.2.2). For 1-path the value must be set to 0	Depending of sensor size selected at ordering	0 to 1.5 m	Write
7.1.4.2.4	Trig. con 2 Up	The signal trigger constant of the second path up. Typically, values between -1.35 and +1.35 are useful; typical value is -0.75	Depending on ordered sensor system	-1.40 to +1.40	Write
7.1.4.2.5	Trig. con 2 Dw	The signal trigger constant of the second path down. Typically, values between -1.35 and +1.35 are useful; typical value is -0.75	Depending on ordered sensor system	-1.40 to +1.40	Write
7.1.4.2.6	AUTO cal. 2	The AUTO calibration factor is automatically calculated **Note:** Only shown if AUTO is selected in menu 7.1.1			Read
7.1.4.2.6	WET cal. 2	The WET calibration factor of the path. **Note:** Only shown if WET is selected in menu 7.1.1	Depending on factory calibration of the transmitter, which is typically done together with the ordered sensor	0.0000010 to 100.0000000 (value with 7 fractional digits)	Write
7.1.4.2.7	WET Flow 2	This value represents the calculated flow **Note:** Only shown if WET is selected in menu 7.1.1	Depending on factory calibration together with ordered sensor		Read

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
7.1.4.3	Track 3				
7.1.4.3.1	Length 3	Length of path 3 (m). The distance between the two ultrasonic transducers of path 3, see Figure 7-6 Sensor geometry data (Page 61).	Depending of sensor size selected at ordering	>0 to 8.0 m	Write
7.1.4.3.2	Angle 3	Angle of path 3	Depending of sensor size selected at ordering	0 to 89°	Write
7.1.4.3.3	Displacement 3	Displacement of path 3 (m) Note: The value must be smaller than the half entered pipe diameter (see menu 7.1.3.2.2).	Depending of sensor size selected at ordering	0 to 1.5 m	Write
7.1.4.3.4	Trig. con 3 Up	The signal trigger constant of the third path up. Typically, values between -1.35 and +1.35 are useful; typical value is -0.75	Depending on ordered sensor system	-1.40 to +1.40	Write
7.1.4.3.5	Trig. con 3 Dw	The signal trigger constant of the third path down. Typically, values between -1.35 and +1.35 are useful; typical value is -0.75	Depending on ordered sensor system	-1.40 to +1.40	Write
7.1.4.3.6	AUTO cal. 3	The AUTO calibration factor is automatically calculated **Note:** Only shown if AUTO is selected in menu 7.1.1			Read
7.1.4.3.6	WET cal. 3	The WET calibration factor of the path. **Note:** Only shown if WET is selected in menu 7.1.1	Depending on factory calibration of the transmitter, which is typically done together with the ordered sensor	0.0000010 to 100.0000000 (value with 7 fractional digits)	Write
7.1.4.3.7	WET Flow 3	This value represents the calculated flow **Note:** Only shown if WET is selected in menu 7.1.1	Depending on factory calibration together with ordered sensor		Read
7.1.4.4	Track 4				
7.1.4.4.1	Length 4	Length of path 4 (m). The distance between the two ultrasonic transducers of path 4, see Figure 7-6 Sensor geometry data (Page 61).	Depending of sensor size selected at ordering	>0 to 8.0 m	Write
7.1.4.4.2	Angle 4	Angle of path 4	Depending of sensor size selected at ordering	0 to 89°	Write
7.1.4.4.3	Displacement 4	Displacement of path 4 (m) Note: The value must be smaller than the half entered pipe diameter (see menu 7.1.3.2.2).	Depending of sensor size selected at ordering	0 to 1.5 m	Write

Menu code	Device function, Parameters	Description	Factory setting	Setting options	Read or write
7.1.4.4.4	Trig. con 4 Up	The signal trigger constant of the fourth path up. Typically, values between -1.35 and +1.35 are useful; typical value is -0.75	Depending on ordered sensor system	-1.40 to +1.40	Write
7.1.4.4.5	Trig. con 4 Dw	The signal trigger constant of the fourth path down. Typically, values between -1.35 and +1.35 are useful; typical value is -0.75	Depending on ordered sensor system	-1.40 to +1.40	Write
7.1.4.4.6	AUTO cal. 4	The AUTO calibration factor is automatically calculated **Note:** Only shown if AUTO is selected in menu 7.1.1			Read
7.1.4.4.6	WET cal. 4	The WET calibration factor of the path. **Note:** Only shown if WET is selected in menu 7.1.1	Depending on factory calibration of the transmitter, which is typically done together with the ordered sensor	0.0000010 to 100.0000000 (value with 7 fractional digits)	Write
7.1.4.4.7	WET Flow 4	This value represents the calculated flow **Note:** Only shown if WET is selected in menu 7.1.1	Depending on factory calibration together with ordered sensor		Read
7.2	No. of tracks	Number of paths connected to the transmitter; typical 1-track (SONO 3100, SONOKIT-1) or 2-tracks (SONO 3100, SONO 3300, SONOKIT-2)	Depending on ordered system configuration	1-track 2-tracks 3-tracks 4-tracks	Write

Ordering/certificates

D

D.1 Ordering

In order to ensure that the ordering data you are using is not outdated, the latest ordering data is always available on the Internet: Process instrumentation catalog (http://www.siemens.com/processinstrumentation/catalogs)

D.2 Certificates

Certificates are posted on the Internet and on the documentation CD-ROM shipped with the device.

See also

Certificates (http://www.siemens.com/processinstrumentation/certificates)

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